THE

PRINCIPLES OF BOTANY,

AND OF

VEGETABLE PHYSIOLOGY.

THE

PRINCIPLES OF BOTANY,

AND OF

VEGETABLE PHYSIOLOGY.

TRANSLATED FROM THE GERMAN

OF

D. C. WILLDENOW,

PROFESSOR OF NATURAL HISTORY AND BOTANY
AT BERLIN.

A NEW EDITION, GREATLY ENLARGED BY THE AUTHOR.

EDINBURGH:
Printed at the University Press;
FOR WILLIAM BLACKWOOD, 64, SOUTH BRIDGE-STREET;
AND T. CADELL AND W. DAVIES, STRAND,
LONDON.

1811.

TO

DANIEL RUTHERFORD, M. D.,

PROFESSOR OF BOTANY

IN THE UNIVERSITY OF EDINBURGH,

THIS WORK IS

MOST RESPECTFULLY INSCRIBED

BY

THE EDITORS.

ADVERTISEMENT

TO THE

FIRST EDITION.

The following work having superseded in Germany all other Introductions to Botany, of the longest standing and greatest reputation, it occurred to the present Editors that a translation of it would be a very acceptable present to the lovers of Natural Science in this country. They do not here intend to draw a comparison between this and the Elementary Treatises on Botany in our own language; but it may be allowable to say that it contains many things which are not to be found in any of them; particularly an explanation of the phenomena of Vegetable Physiology, on the principles of the latest discoveries in Chemistry. There are also added sections on the Diseases of Plants, a History of the Science, and an account of Botanical Writers. The Plates illustrate every Botanical term; and the table of Colours, which is altogether new, will be of essential use to students, not of Botany only, but also of Natural History in general.

ADVERTISEMENT

TO THE

SECOND EDITION.

The success of this Work has induced the Author to revise and improve it. He has altered the arrangement in several places and added a number of new terms, which will not only be of the greatest use to the student in acquiring the knowledge of plants, but will likewise greatly assist those more advanced in the scientific description of them. The Editors have procured the last edition; what is new they have translated, and have carefully attended to those alterations in the arrangement, which the Author had found necessary. An additional explanatory plate has been engraved, and great care has been taken in correcting the Index, so as to make it serve as a glossary of all the terms. In this new Edition likewise many faults in the former have been corrected, and the whole, it is hoped, rendered more worthy of the public attention.

CONTENTS.

Introduction .... page 1
Of the study of Botany .... § 5
Rules for forming a Herbarium .... ib.
Of the Terms used in describing the outer Surface of Plants .... § 6
Of the different Periods of Vegetation .... § 7
Of the Measures used in Botany .... § 8

I. TERMINOLOGY .... page 13

Of the descending Stem .... § 10
Of the intermediate Stem .... § 13
Of the ascending Stem .... § 14
Of the Leaves .... § 42
Of the Frond .... § 44
Of Props .... § 45
Of the Flower and its parts .... § 71
Of the Fruit and its parts .... § 99
Of what is called a false Fruit .... § 115

Of the Seed and its parts .... § 116
Of the Receptacle .... § 119

II. CLASSIFICATION .... page 152

Of Systems, natural, artificial, and sexual .... § 122
Of the natural Families of plants .... § 124
Of Systems in general .... § 126

The System of Caesalpinus .... § 129
———— Morison .... § 130
———— Herrmann .... § 131
———— Knaut .... § 132
———— Boerhaave .... § 133
———— Ray .... § 134
———— Camellus .... § 135
———— Rivinus .... § 136
———— Christian Knaut .... § 137
———— Tournefort .... § 138
———— Gleditcsh .... § 140
———— Haller .... § 141
———— Linnaeus .... § 142
Of the Improvements made in the Linnaean System .... § 145
Of the Natural Orders of Plants .... § 146

III. BOTANICAL APHORISMS .... page 186

Of the Method of acquiring a Knowledge of Plants .... § 148
Of the Genera of Plants, and how to distinguish and establish them .... § 151
Of the Character of Plants .... § ib.
Of their Structure .... § 154

Of the Species and Varieties of Plants .... § 185
Rules for distinguishing Species .... § 186
Of the Method of describing Plants .... § 200
Of the Method of describing the essential difference of Plants only, or, of the Diagnosis of Plants .... § ib.
Of the Varieties of Plants .... § 201
Of the Colours of Plants .... § 202
Of the Method of determining Plants .... § 207

IV. NOMENCLATURE OF PLANTS .. page 232

V. PHYSIOLOGY .... page 245

Of the different Powers of organized Bodies .... § 228
Of the chemical Principles of Plants .... § 233
Of the Substances formed by their Combination .... § 234
Of the different Vessels of Plants, Air-vessels, Lymphatic Vessels, &c. .... § 236
Of the cellular Texture of Plants .... § 241
Of the Sap of Plants .... § 277
Of the transpiring Pores of Plants .... § 284
Of the Temperature of Plants .... § 285
Of the Phenomena of Germination .... § 287
Of the Structure of the Root .... § 260
Of the Structure of the Stem .... § 264
Of the five Varieties of ligneous Plants .... § 266
Of the Structure of the Thorn .... § 269
——————Prickle .... § 270
——————Tendril .... § 271
—————— Pith .... § 272
——————Gem or Bud .... § 273
——————Leaves .... § 274

Of the Inhalation and Exhalation of Plants........ § 275
Of the Circulation of the Sap.................... § 277
Of the green Colour of the Leaves................ § 288
Of their different Duration...................... § 290
Of the Evolution of the Flower................... § 291
Of the Impregnation of Plants..................... § 294
Of their Generation............................... § 300
Of the Death of Plants............................ § 308
Of the various Duration of Life in Plants.......... § 309

VI. DISEASES OF PLANTS..........page 367

External and Internal............................ § 312

VII. HISTORY OF PLANTS..........page 402

Influence of Climate and Soil upon Plants.......... § 356
Of the Revolutions in our Globe, and their Influence upon Vegetation .... § 361
Of the Dissemination of Plants.................... § 365
Of the five principal Floras in Europe............ § 373

VIII. HISTORY OF THE SCIENCE .. page 403

DESCRIPTION OF THE PLATES....page 505

INDEX..................................page 527

PRINCIPLES

OF

BOTANY, VEGETABLE PHYSIOLOGY, &c.

INTRODUCTION.

§ 1.

Of the bodies of which this world consists, some are not to be decomposed by human art, whether mechanical or chemical, these are called Elements, *(Elementa)*; others are compound and consist of elements, these are called Natural bodies, *(Naturalia)*.

The science which teaches the properties of Elements is called Natural Philosophy or Physics, *(Physica)*: but that science by which we become acquainted with the external forms and properties of Natural bodies is called Natural History.—*(Historia naturalis: scientia naturalis.)*

§ 2.

The innumerable multitude of bodies which form the province of Natural History, obliged the writers on that subject, even in the earliest times, to separate it into primary divisions under the name of Kingdoms. Aristotle was the first who established the division into the three well known kingdoms of Nature, namely, the Animal, Vegetable, and Mineral or Fossil Kingdoms*.—(*Regnum animale, vegetabile, lapideum vel minerale.*)

§ 3.

The three kingdoms of Nature differ in their power of propagation. *Fossils* have no organs of generation; they remain always the same, or are only capable of forming various compounds, but never produce their like. *Plants* are furnished with a great number of genital organs; but they lose them before their death, and often acquire fresh sets: *Animals*, on the contrary, retain their organs until death †.

* Some have proposed to add an Aqueous and an Igneous Kingdom; and Munchausen an intermediate kingdom containing the Fungi, Corallia and Polypi; while others have adopted only two kingdoms, the Living and Lifeless; but this last arrangement is insufficient, because the former must be subdivided into Animals and Plants; and in like manner, the proposed new kingdoms of nature are superfluous.

† Various means have been devised for discriminating Plants and Animals; but hitherto no one has been so fortunate as to discover a clear and satisfactory distinction, because nature has not separated them by any accurate limits. Loco-motion, the voluntary motion of particular parts, the orifice by which the food is taken in, and that by which the superfluous parts of it are discharged, are indeed characteristic marks of the

§ 4.

That science which teaches us to distinguish one plant from every other, and leads us to the knowledge of its peculiarities, is called BOTANY, (*Botanice, Botanica, Scientia botanica, Phytologia, Botanologia.)*

To teach this science properly, we must make the student acquainted with every particular part of a plant, and its use. This is the purpose of the following work: but before proceeding, we must premise a few necessary hints and general observations*.

5.

The first object of a student of Botany, after becoming acquainted with the Terminology, is to gain

animal kingdom, and are obvious in the larger animals. But are there not certain plants which are endowed with voluntary motion, and which, in some respects, move from one place to another? and who can shew us, in the infusory animals, or in those allied to them, which resemble the Confervas, the Tremellas, and other small plants, the organs appropriated for the reception of the food or its discharge? (Smellie's philosophy of Natural History, may be consulted for a fuller account of the affinity of these kingdoms.)

* Particular branches of this science have also particular names: for instance, when the subject relates to trees and shrubs alone, it is called *Dendrologia;* when to the grasses, *Agrostographia*, when to those plants whose flowers are not obvious, *Cryptogamologia.* Botany may even according to its various uses be divided into *economical*, *technological*, and *medicinal.*

an accurate knowledge of every plant as it comes in his way. He must acquire what may be called a botanical glance; that is, he must accustom his eye to run over the stem, the leaves in all their structure, the mode of inflorescence, and all the other conspicuous parts of a plant, so as to discover by mere inspection, determinate characters distinguishing it from similar plants. In this way he becomes enabled to know plants by the external appearance or habit *(habitus.)* With this knowledge, however, he must not be contented, but must examine more accurately, the parts of the flower and fruit *(partes fructificationis)*, and be able to find in them certain and fixed characters; and, till he has attained this power, his knowledge cannot be said to rest on scientific principles. To derive the proper advantage from such knowledge, he must endeavour to imprint the form of the plants he sees upon his memory. But, as from the immense number of plants this is almost impossible, and often at particular seasons of the year, plants which we would wish to compare with one another are not to be found, we must endeavour to assist ourselves by a collection of dried plants *(Hortus siccus, Herbarium)*. The rules to be observed in forming such a collection are the following.

1. The plant is to be laid between folds of blossom paper, the parts of it properly spread out, and the paper often changed, that the plant may not shrivel or become black: this is to be done in a moderately warm place, exposed to the sun, and where there is a free current of air.

2. In drying the plant we must take care to give the parts no unnatural direction; for instance, we must not give to a flower, which naturally hangs down, an erect position; flower-stalks that are attached to one side must not be turned to both, a crooked or procumbent stem, must be preserved in that state, &c.

3. The plants must be gathered at that particular time when they possess all the characters by which they are distinguished from similar plants; whether the difference be in the root, in the radical leaves, or in the fruit, these parts, as being essential, must not be wanting.

4. Plants should not be gathered in moist weather, because, in that case they generally turn black in drying; and when it so happens, they must be left to dry for some time in the air.

5. Succulent plants may be dried either with a warm stone or a hot iron; or, what is better, they may be immersed in boiling water for some minutes, and after being carefully wiped dry with blossom paper, treated in the usual way; but the paper must be often changed. The flowers must not be allowed to get wet, but must be gently compressed.

6. Plants, which are succulent, and at the same time delicate, such as the Iris, must be dried between folds of writing paper, after having the capsule slightly bruised; and the paper is not to be opened up till the whole plant is thoroughly dry.

7. The Algae must likewise be dried. Such as grow out of the water, upon stones, the bark of

trees, &c. may be preserved without any further preparation with the bodies on which they are found. The aquatic algae must be spread out under water on fine paper laid over a plate of glass, and gradually, when they are properly disposed on the paper, lifted out of the water and then dried.

8. But the Musci, after being carefully plucked asunder, must be thrown into a vessel of water, and then laid between two leaves of moistened writing paper, which may be put in an old book with a considerable weight on it. Mosses dried in this way, though they may look well, lose in part their natural appearance; it is better therefore ,not to press them too hard, because they can be afterwards easier restored and examined.

9. Pressure is likewise used for thistles and other strong leaved plants.

10. The Fungi in general cannot be dried, except some of the smaller and coriaceous kinds; and a few of the larger ones may be prepared by being immersed in boiling water.

When a collection of dried plants is thus made, they are to be laid each in a sheet of white paper, and arranged according to some system, and kept in a close cabinet, that they may not be eaten by insects. We may also lay in the drawers small bits of spunge moistened with oil of rosemary or cajuput wrapt in paper, which will banish these depredators: even by frequent perusal the collection is preserved from them.

Some botanists, and Linnaeus himself, advise the fastening of the plants to the paper. But many inconveniencies attend this practice; for, we can only see one side of the leaf, and cannot examine the flower at all, especially when it is small. For a botanist it is much better to keep the plant loose, because it is often necessary to soften the flowers by means of warm water, in order to examine their form more accurately; he can also substitute a better specimen occasionally for an indifferent one, and save the time spent in fixing them. If however, it be wished to fix the plants, the object may be attained by pasting slips of paper over the stem, or by means of a thread.

But an Herbarium alone is not sufficient for the purposes of a botanist; he must likewise collect the seeds of most plants and their fruit, especially those that can be preserved, because an acquaintance with these is of the greatest importance to him.

§ 6.

The surface of the different parts of plants is very multifarious. The following terms have been settled, and are used in the description of all these various parts;

1. Shining *(nitidus)*, where the surface is so smooth that it reflects the rays of light, and has a shining or glancing appearance, as in the leaves of the holly, Ilex *aquifolium.*

2. Dull *(opacus)* when the surface does not reflect the rays, and is entirely void of lustre.

3. Even, *(laevis)*, without striae, furrows, or raised dots. It is the opposite of Nos. 6, 7, 23, 24, 25, 28 and 29.

4. Smooth, *(glaber)*, when there are no visible hairs, bristles or thorns. It is the opposite of No. 8—22, 26 and 27.

5. Dotted, *(punctatus)*, where small fine dots are perceived by the eye, but not by the touch. Thymus *vulgaris*.

6. Scabrous, *(scaber)*, where small raised dots are felt but not seen, as in Carex *acuta*.

7. Rough, *(asper)*, when these dots are both felt and seen. Pulmonaria *officinalis*.

8. Hispid, *(hispidus)*, beset with very short stiff hairs. Myosotis *arvensis*.

9. Rigid, *(hirtus)*, where the hairs are moderately long, but very stiff. Echium *vulgare*.

10. Hairy, *(pilosus)*, beset with long single hairs, somewhat bent. Heracium *pilosella*.

11. Villous, *(villosus)*, where the hairs are long, soft and white. Stachys *germanica*.

12. Pubescent, *(pubescens)*, overgrown with short fine white hairs. Oenothera *mollissima*.

13. Silky, *(sericeus)*, when the surface is white and shining, by means of thick and almost invisible hairs. Potentilla *anserina*.

14. Woolly, *(lanatus)*, when the surface is beset with long, thick, white hairs easily distinguished. Stachys *lanata*.

15. Tomentous, *(tomentosus)*, when fine hairs are so matted together that the particular hairs cannot be distinguished. In this case the surface generally appears white, as in Shepherds Club, Verbascum; or of a rust colour, as in Ledum.

16. Bearded, *(barbatus)*, when the hairs are in tufts. Mesembryanthemum *barbatum.*

17. Strigose, *(strigosus)*, when the surface is armed with small, close lying bristles, which are thickest below. Lithospermum *officinale.*

18. Stinging, *(urens)*, where a painful burning sensation is caused by small hairs. Urtica.

19. Fringed, *(ciliatus)*, when on the margin of a leaf, or the surface of a stalk, there is a row of hairs of equal length.

20. Warty, *(papillosus)*, when small fleshy warts appear. Aloe *margaritifera.*

21. Pustular, *(papulosus)*, when there are small hollow bladders. Mesembryanthemum *hispidum.*

22. Muricated, *(muricatus)*, armed with small short herbaceous spines. Asperugo *procumbens.*

23. Scaly, *(lepidotus)*, when the surface is covered with small scales closely placed, by which means the colour is changed, as in Eleagnus *angustifolia.*

24. Mealy, *(farinosus)*, when the surface is thickly covered with a white powder, as in Primula *farinosa.*

25. Hoary, *(pruinosus)*, when the surface is strewed with a very fine white dust, like the fruit of some plumbs. Prunus *domestica.*

26. Glutinous, *(glutinosus)*, when the surface is covered with an adhesive matter, which is soluble in water. Primula *glutinosa.*

27. Viscid, *(viscidus)*, when the surface is covered with a viscid juice which is resinous or greasy. Cerastium *viscosum.*

28. Striated, *(striatus)*, when the surface is finely streaked. Aira *caespitosa.*

29. Furrowed, *(sulcatus)*, when these streaks form small furrows. Umbellae.

§ 7.

To denote the general appearances of vegetation, botanists often make use of figurative expressions. The various periods of vegetation are,

1. Germination, *(germinatio)*, when the seed swells, and begins to unfold its little tender leaves.

2. Vernation, *(frondescentia, vernatio)*, when the swollen buds of trees, shrubs, &c. unfold their leaves.

3. Sleep, *(somnus)*, when in the evening, or during night, the leaves of various plants hang down or collapse.

4. Defoliation, *(defoliatio)*, when in autumn, or, as is the case with a few northern plants, in the spring, the leaves fall off.

5. Virginity, *(virginitas)*, when the flower-buds of plants are not yet unfolded.

6. Expansion, *(anthesis)*, is the time when the flowers of plants are perfectly developed. Thus in descriptions we say the flowers hang down before expansion *(flores ante anthesin nutantes)*; or after expansion they stand erect, *(flores post anthesin erecti.*

7. Estivation, *(aestivatio)*, the month or season of the year when the flower is in perfection.

8. Fructification, *(fructificatio)*, is the period in

plants when the antheræ communicate their dust to the neighbouring parts.

9. Caprification, *(caprificatio)*, that species of impregnation which is not performed immediately by the plants themselves.

10. Watches, *(vigiliæ)*, when flowers open or shut at a particular hour of the day or night.

11. Setting, *(grossificatio)*, when after florescence the future fruit begins to swell.

12. Maturation, *(maturatio)*, when the fruit becomes ripe.

13. Dissemination, *(disseminatio)*, the manner in which the fruit, after it becomes ripe, scatters its seeds.

N. In the Physiology we shall treat particularly of these several periods.

§ 8.

The various sizes of plants and of their parts have given occasion to the following measures.

1. A hair-breadth, *(capillus,)* the measure of a hair, or the twelfth part of a line.

2. A line, *(linea)*, the length of the white crescent at the root of the nail of the middle finger, or the twelfth part of an inch.

3. A nail length, *(unguis)*, the length of the nail of the middle finger, or half an inch.

4. An inch, *(pollex, uncia)*, the length of the first joint of the thumb, the twelfth part of a foot.

5. A hand-breadth, *(palmus,)*, the breadth of the four fingers of the hand, or three inches.

6. A span, *(dodrans)*, as far as one can span with the thumb and the little finger, or nine inches.

7. A small span, *(spithama)*, as far as one can span with the thumb and forefinger, or seven inches.

8. A foot, *(pes)*, the length from the elbow to the wrist, or twelve inches.

9. A cubit, *(cubitus)*, from the elbow to the point of the middle finger, or seventeen inches.

10. An ell, *(ulna, brachium)*, the length of the whole arm or four and twenty inches.

11. A fathom, *(orgya)*, the length of the arms stretched out from the tip of one middle finger to that of the other, or six feet.

These definitions will not be repeated in the sequel, but, when necessary, reference will be made to these paragraphs.

TERMINOLOGY

---

§ 9.

In the descriptions of plants it is necessary that each part have its particular name appropriated to it, that all ambiguity may be removed. Most plants have two principal parts which particularly strike us, namely the *descending stem*, (caudex descendens) and the *ascending* (adscendens). In some there is even a third part, namely the *intermediate stem*, (Caudex intermedius).

§ 10.

The descending stem (*Caudex descendens*) is that part of the plant which takes its direction downwards. In most plants it enters the earth; in others it adheres to extraneous bodies which serve for its point of attachment, as in Lichens and some tuberous parasitical plants; and lastly in some it penetrates the substance on which it fixes itself, as in the Viscum, Loranthus and others.

The descending caudex takes the name of *Root* (radix) The parts of which the root consists are the *Rhizoma*, the *Fibrillæ*, the *Radiculæ*, the *Tuber*, the *Bulbus*, and the *Soboles*.

§ 11.

The Rhizoma is that part of a biennial or lasting root, more or less thick, which appears in different forms. In biennial and perennial plants it is for the most part fleshy; in shrubs and trees it is woody; and in all, in two or more years, according to the nature of the plant, it sets off one or more shoots, *(Turiones)*, as in Daucus *Carota*, Polypodium *vulgare*, Astragalus, &c.

The Fibrillae are those parts of the root which have the appearance of threads, and are sometimes straight and sometimes variously bent; they are attached to the Rhizoma, the tubercles or bulbs, and sometimes to the intermediate part (§ 13). There are roots which have no Rhizoma, and consist entirely of these fibrillæ.

The Radiculae are extremely fine and hair-like prolongations of the root, which are properly but absorbent vessels or their prolongations, by which the plants are nourished. They are sometimes so fine that we can scarcely observe them with the naked eye, and, like the leaves, they are, in lasting roots, renewed yearly.

The Tuber is a thick fleshy part of the root, of various figure, which produces one or more bodies similar to itself and then perishes; and from its whole surface, or from its top, or its base, one or more shoots proceed; e. g. Solanum *tuberosum*, Spiræa *Filipendula*, Orchis and others.

The BULBUS is a fleshy, coated body, more or less solid, round and gross, that is firmly united with a root small in respect of the bulb, which is placed sometimes at the base and sometimes in the middle. It pushes its shoot either from the middle or the base, which depends on the situation of the root, (Rhizoma).

The SOBOLES is a prolongation of the root, proceeding horizontally under the earth, for the most part filiform, and producing new plants of its kind, e. g. Triticum *repens*, and many others.

§ 12.

According to most of the above named parts the different species of roots may be divided and named, viz. *Rhizomatoideæ*, *fibrillatae*, *tuberosæ*, *bulbosæ*, and *nothæ*, or spurious ones. To this last division belong those roots which do not enter the earth, but are otherwise attached. The kinds of roots are,

a. Rhizomatoïdeae.

1. Woody, *(lignosa)*, composed of a woody substance and numerous woody fibres; such as that of trees and shrubs.

2. Fleshy, *(carnosa)*, consisting of a fleshy substance more or less firm; as Daucus *Carota*, Pastinaca *sativa*.

3. Hollow, *(cava)*, that is always hollow in the middle, as Fumaria *bulbosa*.

4. Partitioned, *(loculosa)*, an oblong root, internally furnished with separated cavities; as Cicuta *virosa.*

5. Intire, *(integra)*, never naturally internally hollow, and thus the opposite of the two last mentioned.

6. Cylindrical, *(cylindracea)*, that comes nearest to a cylindrical figure, and is thick, as Dictamnus *albus.*

7. Spindle-shaped, *(fusiformis)*, cylindrical above, and tapering to a point as it descends, as in Daucus *Carota*, Pastinaca *sativa.*

8. Bitten, *(præmorsa)*, where the principal root seems as if it were bitten off, as Scabiosa *succisa*, Plantago *major.*

9. Worm-like, *(vermicularis)*, thick and almost cylindrical, but bent in different places; Polygonum *Bistorta.*

10. Turnip-shaped, *(napiformis)*, bellying out above, but below ending in a long taper point. Brassica *Rapa.*

11. Roundish, *(subrotunda*, seu *globosa)*, that is almost spherical, as Raphanus *sativus*, Bunium *Bulbocastanum.*

12. Flat, *(placentiformis)*, a thick round root, which both above and below is compressed, so that it almost resembles a plate, *Cyclamen.*

13. Jointed, *(geniculata)*, divided into members from which the root-fibres proceed, Gratiola *officinalis.*

14. Scaly, *(squamosa)*, covered with more or fewer fleshy scales. Lathræa *squamaria.*

15. Toothed, *(dentata)*, a fleshy branched root

having teeth-like prolongations. Cymbidium *corallorhiza.*

16. Tufted, *(comosa)*, having as it were tufts of hair at its points, which are the fragments of the leaf foot-stalks divided like fibres. Aethusa *Meum.*

17. Many-headed, *(multiceps)*, divided at top into numerous branches from which new shoots spring; as Astragalus, Geranium *macrorhizon.*

18. Simple, *(simplex)*, having no branches.

19. Branching, *(ramosa)*, dividing into branches, as all trees, shrubs, and many plants.

20. Perpendicular, *(perpendicularis)*, going straight down into the earth; as Thlaspi *bursa pastoris.*

21. Horizontal, *(horizontalis)*, running horizontally under ground; as Polypodium *vulgare*, fig. 15.

22. Oblique, *(obliqua)*, going neither perpendicularly nor horizontally into the earth, but obliquely; as Aethusa *Meum.*

23. Creeping, *(repens)*, lying horizontally under the earth, and extending itself in that direction by means of side-branches; as Rumex *Acetosella.*

24. Ringed, *(annulata)*, furnished on its upper surface with alternately raised and depressed bands.

25. Knobbed, *(tuberculata)*, furnished on its upper surface with protuberances; as Aethusa *Meum*, Bunium *Bulbocastanum.*

26. Scarred, *(cicatrisata)*, which, upon the perishing of the stem, has depressions or chinks on its upper surface; as Polypodium *vulgare.*

27. Chaffy, *(paleacea)*, covered with membranaceous scales, as many of the Filices.

28. Even, *(laevis)*, marked on its surface neither with elevations nor depressions.

b. Fibrillatae.

29. Thread-like, *(filiformis)*, consisting of a simple fibre.

30. Fibrous, *(fibrosa)*, consisting of many fibrous roots; as Poa *annua.*

31. Hair-like, *(capillaris)*, consisting of numerous very fine fibres; as Scirpus *acicularis.*

32. Velvet-like, *(velutina)*, composed of very tender and hardly visible fibres; as in the Musci frondosi.

33. Cleft, *(fissa)*, very short, and at the point dividing into two or three parts; as Peltidea *canina.*

c. Tuberosae.

34. Knobbed, *(granulata)*, the knobs formed like small grains of corn; as Saxifraga *granulata*, fig. 5.

35. Testiculated, *(testiculata)*, when two, rarely three long or roundish knobs hang from the point from which a shoot rises; as in Orchis, fig. 18.

36. Palmated, *(palmata)*, when two, rarely three longish depressed knobs, which are divided at the point, hang together, as in the last; e. g. Orchis, fig. 16.

37. Fingered, *(digitata)*, when a single fleshy knob is compressed, and divided at the point like fingers; as Dioscorea *alternifolia.*

38. Bundled, *(fasciculata)*, when many cylindrical or longish roots hang together from the point, so

as to resemble a bundle; Ranunculus *Ficaria*, Epipactis *Nidus avis*. fig. 21.

39. Globulated, *(conglobata)*, when several round knobs sit upon one another; as Helianthus *tuberosus*.

40. Depending, *(pendula)*, when several knobs hang together from fibrous roots; Solanum *tuberosum*, Spiræa *Filipendula*. fig. 12.

41. Articulated, *(articulata)*, when one knob grows out of another, so that the whole seems to consist of connected members.

42. Necklace-like, *(moniliformis)*, when many knobs hang together by a fibrous root, in rows, as if they were strung on; as Pelargonium *triste*.

d. Bulbosae.

43. Imbricated, *(imbricata* s. *squamosa)*, when the bulb consists of leaves lying over one another like the tiles of a house; as Lilium *bulbiferum*. fig. 19.

44. Coated, *(tunicata)*, when the bulb is composed of concentric layers; as in Allium *Cepa*, fig. 17.

45. Net-like, *(reticulata)*, when the bulb is entirely composed of reticulated membranes; as Allium *Victorialis*.

46. Half-net-like, *(semireticulata)*, when the bulb consists of a firm mass, but the outer membrane is net-like; as Gladiolus *communis*.

47. Solid, *(solida)*, when the bulb consists of a firm substance throughout; as Colchicum *autumnale*.

48. Nestling, *(nidulans)*, when small bulbs appear

under the external membrane, and the bulb seems to be entirely composed of them; as in Ornithogalum *spathaceum.*

49. Aggregated, *(composita* s. *aggregata),* when several bulbs stand close together, having a connection at the base.

50. Twofold, *(geminata),* when two bulbs are connected by their base; as Fritillaria *pyrenaica,* Erythronium *Dens canis.*

51. Doubled, *(duplicata),* when one bulb stands above another, and grows out of it; as Allium *sphaerocephalon.*

52. Supported, *(suffulta),* when the body of the root stands at a distance from the bulb, equalling it in size and distinctly separated from it; as Ixia *punicea, erecta.*

53. Single, *(solitaria),* when neither from the side nor from the base proceeds another bulb.

54. Central, *(centralis),* when the shoot proceeds from the middle; as Galanthus *nivalis.*

55. Lateral, *(lateralis),* when the shoot issues from the side; as in Ixia *virgata.*

c. Nothae.

56. Divided, *(divisa),* that branches out above stones or other bodies, but does not penetrate into the earth; as Fucus *digitatus.*

57. Byssus-like, *(byssacea),* that is divided like wool, and has the appearance of a filamentary byssus; as many species of Agaricus.

58. Warty, *(papillosa),* consisting of short wart-

like small dots, by which the plant attaches itself to wood or stones; as in Lichen.

59. Shield-like, *(scutiformis)*, when the base of the ascending stem spreads itself into a thin surface, by which the plant is attached to wood or stones; as Lichen *floridus*, Ceramium *Filum*, Umbilicaria *pustulata*.

60. Fading, *(evanescens)*, when the descending stem penetrates into wood and therein gradually disappears; as Viscum *album*.*

§ 13.

The Intermediate Stem, (Caudex intermedius) is that part of the plant which neither belongs to the ascending nor to the descending stem. It is peculiar to some plants only, and has nearly the appearance of a root or a stem. It is denominated,

1. Root-like, *(radiciformis)*, when it has the appearance of a tuberous root, but is situated above the soil, or half above and half below it. According to its form it is called,

   a. Turnip-shaped, *(napiformis)*, when it has the form of a Turnip (§ 12. n. 10.) but is above ground, as Brassica *oleracea gongylodes*.

   b. Bulb-like, *(bulbosus)*, when it resembles a solid bulb (§ 12. n. 47.) but is situated half

* By the accurate description of the root, the form and varieties of the surface in the tuberous and bulbous root are shewn, so that the place is ascertained whence the fibres proceed.

above and half under ground; as Ranunculus *bulbosus*, Avena *bulbosa*.

2. Stem-like, *(cauliformis)*, which penetrates under the soil, has the appearance of the stem and loses itself in it. According to its surface it is called,

a. Even, *(lævis)*, marked on its surface neither with elevations nor depressions; as Lilium *bulbiferum*.

b. Scarred, *(cicatrisatus)*, having elevations on its surface, caused by the remains of the leaf-stalks; as Cyclamen *europæum*.

§ 14.

The ASCENDING STEM, (Caudex adscendens) is the prolongation of the plant above the soil, or above the substance which serves for its production. In respect of this organ, plants exhibit a very great diversity; and the greater number of descriptive marks are taken from its various forms. The following divisions of it have been made—The *Stock* (Cormus), the *Inflorescence*, (Inflorescentia), the leaves, (Folia), the *Frond*, (Frons), the *Props*, (Fulcra), the *Flowers*, (Flores), the *Fruit*, (Fructus), and the *Base*, (Basis).

§ 15.

The STOCK (Cormus) is that part of the plant which serves for the support of the whole, and bears the inflorescence, the leaves, the frond, the props, the flowers and fruit. From it are evolved in most cases all these parts; but amid the vast diversities which prevail in the vegetable kingdom, it will not be surprising that this part should put on very various appearances. Accordingly, the following twelve kinds have been distinguished: viz. the *Stem* (Caudex), the *Trunk* (Truncus), the *Stalk* (Caulis), the *Straw* (Culmus), the *Scape* (Scapus), the *Stipe* (Stipes), the *Shoot* (Surculus), the *Sarment* (Sarmentum), the *Sucker* (Stolo), the *leaf-stalk* (Petiolus), the *flower-stalk* (Pedunculus), and the *bristle* (Seta).

§ 16.

The Stem (Caudex) is a simple perennial rod, with leaves at its extremity, peculiar only to the Palms and arboreous Filices, having no bark, but set round with the remains of the leaf-stalks. Of this there are the following kinds:

1. Ringed, *(annulata)*, when the remains of the leaves at regular distances resemble annular elevations; as Corypha *rotundifolia.*

2. Scaly *(squamosus)*, when the remains of the leaves surround the stem irregularly; as in Phoenix *dactylifera,* Chamaerops *humilis.*

3. Tessellated, *(tessulatus)*, when the leaf, or the base of the stipe (§ 21.) does not remain behind, but leaves a scar, by which the stem puts on a tessellated appearance; as, Polypodium *arboreum.*

4. Aculeated, *(aculeatus)*, when the remains of the leaf are set with prickles; as in Cocos *aculeatus,* Polypodium *asperum.*

5. Smooth, *(inermis)*, the opposite of the last,

when the remains of the leaf leave no prickles; as Phoenix *dactylifera*, Polypodium *arboreum*.

§ 17.

The TRUNK (Truncus) is peculiar to trees and shrubs, and is perennial. The principal stem in these plants has obtained the following denominations; its principal divisions are called branches (Rami), and its subdivisions twigs (Ramuli).

1. Tree-like, *(arboreus)*; this is simple, and forms at top a crowd or crown of branches (cacumen); it is peculiar to trees.

2. Shrubby, *(fruticosus)*, divided below into a number of branches, like all shrubs.

§ 18.

The STALK (Caulis) is herbaceous, seldom woody, and lasts but one or two years; hence it is proper only to herbaceous plants: however the term is sometimes applied both to trees and shrubs. The divisions of this are also called branches (Rami), The kinds are,

a. *With respect to division*:

1. Very simple, *(simplicissimus)*, that has no branches, nor is its flower-stalk divided; consequently it can have but one flower or spike, and no flowers in the axillae of the branches.

2. Simple, *(simplex)*, having no branches, but whose flower-stalk may be divided.

3. Somewhat branched, *(subramosus)*, sometimes without branches, sometimes with one or two.

4. Branched, *(ramosus)* which is always furnished with branches.

5. Much branched, *(ramosissimus)*, where all the branches are not only divided but subdivided.

6. Disappearing, *(deliquescens)*, branched, but so divided that the principal stem is no longer to be observed, but is lost in the ramification.

7. Intire, *(integer)*, which is branched, but where the principal stem can be traced to the point.

8. Verticillated, *(verticillatus)*, when a number of branches are formed at the extremity, from the centre of which the principal stem proceeds, so that the branches at certain distances surround the stem in a circular manner: as in Pinus *sylvestris*.

9. Proliferous, *(prolifer)*, where the stem is divided into a number of branches, and these again likewise divide, but the principal stem does not proceed from the centre of them; as, Ledum *palustre*.

10. Dichotomous, *(dichotomus)*, when the stem, even to the smallest branches divides itself into two; as Viscum *album*, Valeriana *olitoria*

b. *In respect of the Branches.*

11. Alternate branches, *(ramis alternis)*. The branches are so placed that between two on the one side there rises but one on the opposite side.

12. Opposite branches, *(ramis oppositis)*, when one branch stands on the opposite side to another, and the bases of each nearly meet together.

13. Distichous, *(distichus)*, when the branches being opposite to each other, stand on the same plane.

14. Scattered, *(sparsus)*, when the branches stand without order on the stem.

15. Close, *(confertus)*, when the branches stand so thick, and without order, that no empty space remains between them.

16. Brachiate, *(brachiatus)*, when opposite branches stand at right angles to each other, or cross-wise.

17. Rod-like, *(virgatus)*, when the branches are very long, weak and thin.

18. Panicled, *(paniculatus)*, when a stem at its point is divided into numerous leaves and flower-bearing branches; as Rumex *Acetosella.*

19. Fastigiate, *(fastigiatus)*, when all the branches from bottom to top are of such different lengths that they are of equal height.

20. Compact, *(coarctaus)*, where the tips of the branches are bent inwards towards the stem.

21. Spreading, *(patens)*, when the branches stand nearly at right angles with the stem.

22. Diverging, *(divergens)*, where the branches form a right angle.

23. Divaricated, *(divaricatus)*, where the branches are so situated that they form an obtuse angle above, and an acute angle below.

24. Deflected, *(deflexus)*, the branches hang down forming an arch.

25. Reflected, *(reflexus)*, where the branches hang so much down that they almost run parallel with the stem.

26. Retroflected, *(retroflexus)*, where the branches are bent towards every side.

c. *In respect of strength.*

27. Stiff, *(rigidus)*, that will not bend without breaking.

28. Brittle, *(fragilis)*, that breaks with the smallest force.

29. Flexible, *(flexilis)*, that can be bent in any direction without breaking.

30. Tough, *(tenax)*, that can be bent without breaking and can with difficulty be torn.

31, Lax, *(laxus)*, that is firm, but moves with the smallest breath of wind.

32. Parasitical, *(parasiticus)*, that fixes itself by its root, on the root or wood of other plants; as, Viscum, Monotropa.

33. Erect, *(erectus)*, when the stem stands nearly perpendicular.

34. Straight, *(strictus)*, where the stem is perpendicular, and quite straight.

35. Weak, *(debilis)*, when the stem is too slender to maintain itself perfectly upright.

36. Bent upwards, *(adscendens)*, when the stem lies on the ground, but the extremity of it stands erect.

37. Bent downwards, *(declinatus)*, when the stem is so bent towards the earth that it forms an arch.

38 Supported, *(fulcratus)*, that from above sends roots down into the earth, which afterwards change into real stems, as in the Rhizophora.

39. Stooping, *(cernuus)*, when the point in an upright stem takes a horizontal direction.

40. Nodding, *(nutans)*, when the point is bent down towards the horizon.

41. Pendulous, *(pendulus)*, when a parasitical plant (No 32) has its base turned towards the zenith, and its top towards the earth.

42. Procumbent, *(procumbens, prostratus, humifusus)*, when the stem lies flat on the ground.

43. Decumbent, *(decumbens)*, when the stem is upright below, but above is bent down towards the ground, so that the greatest part of it is bent.

44. Creeping, *(repens)*, when the stem lies along, and sends out roots from below.

45. Sarmentose, *(sarmentosus)*, when the stem lies along, but sends out roots only at certain intervals, fig. 20.

46. Rooting, *(radicans)*, when the stem stands upright and climbs, every where sending forth small roots by which it holds itself fast; as in the ivy, Hedera *Helix*.

47 Swimming, *(natans)*, lying on the surface of water; as Polygonum *amphibium*.

48 Sunk, *(demersum)*, that lies below the surface; as Ceratophyllum *demersum*, Utricularia, fig. 288.

49 Flexuose, *(flexuosus)*, where the upright stem bends itself in a zig-zag manner, so as to form a number of obtuse angles. fig. 14.

50 Climbing, *(scandens)*, a weak stem that fastens itself to some other body for support; as the passion-flower, Passiflora *cærulea*.

51. Twining, *(volubilis)*, a weak stem that twines in a serpentine form round other plants; it is of two kinds.

a. Turning from the right, *(dextrorsum)*, when the stem twines from the left to the right, round a supporting body, as in the bindweed, Convolvulus, fig. 25.

b. Turning from the left, *(sinistrorsum)*, when the stem twines from the left to the right, round a supporting body, as in the hop, Humulus *Lupulus*. Fig. 32.

e. *In respect of Clothing.*

52. Naked, *(nudus)*, having no leaves, scales, or the like.

53. Leafless, *(aphyllus)*, without any leaves.

54. Scaly, *(squamosus)*, covered with scales.

55. Ramentaceous, *(ramentaceus)*, that is covered with dry membranaceous scales; as Erica *ramentacea*. (§ 47.)

56. Stipulate, *(stipulatus)*, furnished with stipulae in the axillae of the leaves; (§ 46.) as Vicia *sativa*.

57. Exstipulate, *(exstipulatus)*, without stipulae.

58. Leafy, *(foliosus)*, having leaves.

59. Perfoliate, *(perfoliatus)*, where the stem goes through a leaf; as Bupleurum. fig. 38.

60. Winged, *(alatus)*, when a leaf-like membrane runs along the stem, fig. 265.

61. Bulb-bearing, *(bulbifer)*, having bulbs or tubercles in the axillae of the leaves; as Lilium *bulbiferum*, Dentaria *bulbifera*.

62. Prickly, *(aculeatus)*, when along the stem there are pointed protuberances coming off with the rind. (§ 68).

63. Spiny, *(spinosus)*, when there are pointed protuberances on the stem that do not come off with the rind. (§ 67).

64. Smooth, *(inermis)*, having neither prickles nor spines.

65. Barren, *(sterilis)*, bearing no flowers.

66. Fruitful, *(fructificans)*, bearing flowers, or fruit.

f. *In respect of Figure.*

67. Round, *(teres)*, that is quite cylindrical, fig. 25, 27, 32.

68. Half-round, *(semiteres)*, that is round on the one side, and flat on the other, fig. 235.

69. Compressed, *(compressus)*, when the stem is flat on both sides.

70. Two-edged, *(anceps)*, when a compressed stem is sharp on both edges.

71. Angled, *(angulatus)*, when a stem has several angles, but the sides are grooved. Of this there are several kinds. *viz.*

α. Obtuse.angled, *(obtuse angulatus)*.
β. Acute-angled, *(acute angulatus)*.
γ. Three-angled. *(triangularis)*.
δ. Four-angled, *(quadrangularis, &c.)*, fig. 237.
ε. Many-angled, *(multangularis)*.

72. Three-sided, *(triquetrus)*, where there are three sharp corners, and the sides quite flat, fig. 236.

73. Three-cornered, *(trigonus)*, when there are three round or obtuse edges, but the sides appear flat. Of this too there are several kinds :

α. Four-cornered, (*tetragonus*), fig. 29.
β. Five-cornered, (*pentagonus*).
γ. Six-cornered, (*hexagonus*).
δ. Many-cornered, (*polygonus*).

74. Membranaceous, (*membranaceus*). When the stem is compressed and thin like a leaf.

75. Knotted, (*nodosus*), when the stem is divided by knobs.

76. Knotless, (*enodis*), when it has neither knobs nor joints.

77. Articulated, (*articulatus*), when the stem has regular knobs at the joints, as in Cactus, fig. 233.

78. Jointed, (*geniculatus*), when a stem has regular knobs not seated on the joints.

g. *In respect of Substance.*

79. Woody, (*lignosus*), that consists of firm wood.

80. Fibrous, (*fibrosus*), that consists of woody fibres, that can be easily separated.

81. Herbaceous, (*herbaceus*), that is weak, and can be easily cut.

82. Fleshy, (*carnosus*), that is nearly as juicy and soft as the flesh of an apple.

83. Firm, (*solidus*), internally hard.

84. Empty, (*inanis*), filled internally with a soft pith.

85. Hollow, (*fistulosus*), without any pith within, and quite hollow.

86, With separations, (*septis transversis interstinctus*), where either the pith or the hollow space is divided by thin partitions.

87. Cork-like, *(suberosus)*, when the outer rind is soft and spungy ; as in the Ulmus *suberosa*.

88. Rifted, *(rimosus)*, when there are in the rind thin clefts or chinks *.

89. Scarred, *(cicatrisatus)*, having scars formed by the falling off of the leaves.

§ 19.

The STRAW (Culmus) is proper only to the grasses. The kinds of it are nearly the same with those of the stem. The following however may here be remarked.

1. Knotted, *(nodosus)*, furnished with enlarged joints, as most of the grasses.

2. Knotless, *(enodis)*, without any such enlarged joints, Juncus, Carex, Scirpus.

3. Simple, *(simplex)*, having no branches.

4. Branched, *(ramosus)*, furnished with branches.

* The surface of the stem has also many varieties ; see § 6. When a sort of stem occurs in plants which does not come under the above definitions exactly, we use the word *sub*, as in the leaves, § 23, and in other parts of plants : accordingly we say, *caulis subaphyllus*, *subteres*, &c. that is, a stem almost leafless, somewhat round, &c.

Most plants are furnished with a stem, there being very few that want it ; hence they may be divided into such as have a stem (plantae caulescentes), and those that have none (acaules), such as Viola *odorata*. In these last the other parts generally proceed from the root or from an intermediate stem. But plants whose leaves and flowers come immediately from the root must be denominated plantae acormosae ; as Colchicum *autumnale*, &c.

5. Leafy, *(frondosus)*, furnished with irregular branches, and particularly with small leaves, as Restio.

6. Sheathed, *(vaginatus)*, that is covered with a foliaceous vagina.

7. Naked, *(nudus)*, having neither a foliaceous vagina nor any leaves.

8. Erect, *(erectus)*, standing quite upright.

9. Geniculated, *(geniculatus* s. *infractus)*, when the first and undermost joint lies prostrate, and the rest stand upright, so that by this flexure nearly a right angle is formed, as in Alopecurus *geniculatus.*

10. Oblique, *(obliquus)*, having such a direction as to be intermediate between perpendicular and horizontal; as Poa *annua.*

§ 20.

The SCAPE, *(Scapus)* is an herbaceous stem that bears flowers but not leaves, and proceeds from the descending or intermediate, but never from the ascending stem. It is proper to the Lilies, and is sometimes found in other plants; but in this last case it ought to bear more than one flower, fig. 44; for had it but one flower it would be called Pedunculus radicalis, § 25; it is only when this single flower sits on a flower-stalk proceeding immediately from the ground that it is called Scape.*

* In the compound flowers, the stalk that issues immediately from the earth, bearing only flowers, is constantly called Scape.

§ 21.

The Stipe, *(Stipes)*. This term is applied only to the Filices, Fungi and Palms. The following are the kinds of it.

a. In the Filices.

1. Chaffy, *(paleaceus)*, when it is covered with dry membranaceous scales.

2. Scaly, *(squamosus)*, when it is covered with foliaceous scales, fig. 9.

3. Naked, *(nudus)*, without any covering.

4. Prickly, *(aculeatus)*, having prickles.

5. Smooth, *(inermis)*, without prickles.

b. In the Fungi.

6. Fleshy, *(carnosus)*, of a fleshy substance.

7. Leathery, *(coriaceus)*, consisting of a tough leather-like substance, as Boletus *perennis*.

8. Firm, *(solidus)*, consisting within of a solid mass.

9. Hollow, *(fistulosus)*, forming throughout a hollow cylinder.

10. Pitted, *(lacunosus)* having depressions on the outside, as Helvella *sulcata*.

11. Scaly, *(squamosus)*, covered with firmly attached scales.

12. Squarrose, *(squarrosus)*, covered with scales which are turned back at the points.

13. Raised, *(peronatus)*, that from the bottom to the middle is laid thick over with a woolly substance ending in a sort of meal.

14. Bellying, *(ventricosus)*, thicker in the middle than at either end.

15. Bulb-like, *(bulbosus)*, that is thick immediately above the root.

§ 22.

The Shoot, *(surculus)*, is a term applied to the stem which bears the leaves of the mosses. Of this there are the following varieties.

1. Simple, *(simplex)*, having no branches, as in the Polytrichum *commune*, fig. 139, 142.

2. Branched, *(ramosus)*, dividing into branches, as in Mnium *androgynum*, fig. 138.

3. With hanging branches, *(ramis deflexis)*, when the stem is branched, but all the branches hang down, as in Sphagnum *palustre*.

4. Irregular, *(vagus)*, branched, but the branches set on without order.

5. Intricate, *(intricatus)*, branched, and the numerous protuberant branches running into one another.

6. Tree-like, *(dendroides)*, standing erect, and at the point a crowd of thick branches, like the top of a tree.

7. Pinnated, *(pinnatus)*, having at two opposite sides simple branches of nearly the same length at equal angles with the stalk.

8. Doubly pinnated, *(bipinnatus)*, having the habit of the last, only that its branches are again divided like those of the principal stem, as Hypnum *parietinum*.

9. Trebly pinnated, *(triplicato-pinnatus)*, like the

last, but the secondary branches are also pinnated, as Hypnum *recognitum.*

10. Proliferous, *(prolifer)*, when in either of the two last kinds there shoots forth a new stem out of the old, as in Hypnum *proliferum.*

11. Erect, *(erectus)*, which rises perpendicularly, as in Polytrichum *commune.*

12. Prostrate, *(procumbens)*, lying along.

13. Creeping, *(repens)*, the same with the last, but the branches constantly lengthening and putting forth small roots.

14. Floating, *(fluitans)*, swimming under water in a perpendicular direction, and attached to some fixed body, as Fontinalis *antipyretica.*

§ 23.

The Sarment, *(Sarmentum)*, is a filiform stem, springing from the root, that shoots from the point, sends forth roots and produces a new plant of the same kind, as Saxifraga *sarmentosa*, Fragaria.

The Sucker, *(stolo)*, is a foliaceous creeping stem springing from the root, covered on its under surface with small roots, but at the point bearing a number of leaves from which comes a new plant, as Ajuga *reptans*, Hieracium *Pilosella.*

§ 24

The leaf-stalk, *(petiolus)*, is that kind of stem which is situated at the base of the leaf. The kinds are called ;

1. Round, *(teres)*, whose transverse section appears circular.

2. Half-round, *(semiteres)*, flat on one side and round on the opposite.

3. Compressed, *(compressus)*, flat on both sides, as the Populus *tremula*.

4. Channelled, *(canaliculatus)*. which on its upper side has a deep furrow, as Tussilago *Petasites*.

5. Winged, *(alatus)*, furnished on each side with a leaf-like appendage, as Citrus *Aurantium*.

6. Inflated, *(inflatus)*, thicker in the middle than at either end, as Trapa *natans*.

7. Glandular, *(glandulosus)*, seated on a gland, as Prunus *Padus*, Salix *pentandra*.

8. Eglandular, *(eglandulosus)*, having no gland.

9. Common, *(communis)*, bearing several small leaves, as in the compound leaves.

10. Partial, *(partialis* s. *proprius)*, the leaf-stalk which in a compound leaf bears the leafets.

§ 25.

The FLOWER-STALK, *(pedunculus)*, is found close under the flower, and may either be a principal stem or a scape, as in fig. 23, 27, 38, 44. The sorts are,

1. One flowered, *(uniflorus)*, bearing only one flower, fig. 23, 27.

2. Two or three-flowered, &c. *(bi-triflorus)*, &c.

3. Common, *(communis)*, when several flower-stalks unite in a common one.

4. Partial, *(partialis)*, each single stalk that stands on a general flower-stalk. This flower stalk is much

branched, and the partial stalks are then called *Pedicelli, pediculi.*

5. Scape-like, *(scapiformis)*, when an upright leafless flower-stalk, bearing many flowers, stands at the base of the stem of the plant, or on a creeping stem, fig. 228.

6. Radical, *(radicalis)*, when a single flower-stalk rises from the root, as in the violet, Viola *odorata*, fig. 20.

7. Petiolar, *(petiolaris)*, when the flower-stalk is inserted in the leaf-stalk.

8. Axillary, *(axillaris)*, when it is fixed in the angle between the stem and the leaves.

9. Lateral, *(lateralis)*, when the flower-stalk is found on the branches where there are no leaves, or on the shoots of the former year, as in Erythroxylon, fig. 308.

10. Alar, *(alaris)*, standing in the axillae of the branches, as in Linum *Radiola*, Hopæa *dichotoma*.

11. Opposite, *(oppositiflorus)*, when the particular flower-stalks stand quite opposite to one another.

12. Opposite to the leaf, *(oppositifolius)*, when it stands on the other side exactly opposite to the leaf.

13. Beside the leaf, *(laterifolius)*, when it sits on the stem by the side of the leaf.

14. Under the leaf, *(extrafoliaceus)*, when it is seated under the leaf.

15. Between the leaves, *(intrafoliaceus)*, when it is seated on the stem between the leaves.*

* The flower-stalk, like the stem, is described according to its figure and surface. The regular division of it forms the Inflorescence. (§ 27.)

§ 26.

The BRISTLE, *(seta)*, is that sort of stalk which bears only the fructification of the Musci frondosi and Jungermanniæ. It differs from the flower-stalk in that it is always simple, and stands between the fruit and the calyx; hence the stalk which supports the fruit of the genus Marchantia is a true flower-stalk. The kinds of the bristle are,

1. Single, *(solitaria)*, when there is but one bristle; fig. 138, 139.

2. Aggregate, *(aggregata)*, when several stand close together.

3. Terminating, *(terminalis)*, when it stands on the apex of the Moss, fig. 138, 139.

4. Axillary, *(axillaris)*, when it rises on the stem at the base of the leaves.

5. Rough, *(exasperata)*, when its upper surface is set with small raised dots.

6. Even, *(laevis)*, when it has no raised dots.*

§ 27.

The INFLORESCENCE, *(inflorescentia)*, is the way in which the flower-stalk is divided or formed. In many plants it is an important character, and the following kinds have been described, viz.; The Whirl, *(Verticillus)*, the Head *(capitulum)*, the Ear *(spicula)*, the Spike *(spica)*, the Raceme *(racemus)*, the Fas-

* By the term Rachis is understood the undivided general flower-stalk in a spike, § 31. or Raceme § 32. and even in a Catkin § 40. The middle rib of a leaf has also the same denomination.

cicle *(fasciculus)*, the Umbel *(umbella)*, the Cyme *(cyma)*, the Corymb *(corymbus)*, the Panicle *(panicula)*, the Thyrse *(thyrsus)*, the Spadix *(spadix)*, the Catkin *(amentum)*, and finally the Mass *(sorus)*,

§ 28.

A WHIRL, *(verticillus)*, consists of several flowers that encircle the stem, and stand uncovered at intervals upon it. Of this there are the following kinds:

1. Sitting, *(sessilis)*, when all the flowers sit close to the stem without foot-stalks, as in the field mint, Mentha *arvensis*.

2. With a foot-stalk, *(pedunculatus)*, when the flowers are furnished with short foot-stalks.

3. Headed, *(capitatus)*, when the flowers stand so thick that they take the figure of a half sphere; as, Phlomis *tuberosa*.

4. Half, *(dimidiatus)*, when the flowers surround only the half of the stalk, as in balm, Melissa *officinalis*.

5. Close, *(confertus)*, when one whirl stands close above another.

6. Distant, *(distans)*, when the whirls stand at a distance from one another.

7. Leafy, *(foliosus)*, when there are leaves at the base of the whirl.

8. Leafless, *(aphyllus)*, when there are no leaves about the whirl.

9. Bracteate, *(bracteatus)*, when there are floral leaves, or bracteae (§ 48) at the whirl.

10. Ebracteate, *(ebracteatus)*, when there are no bracteae at the whirl.

11. Naked, *(nudus)*, when no leaves or bracteae stand near the whirl.

12. Six, eight, ten, or many-flowered, *(sex, octo, decem,* s. *multiflorus)*, when the whirl consists of many flowers.

§ 29.

The HEAD, *(capitulum)*, is a number of flowers standing thick upon one stalk so as to form a round head. The flowers have either foot-stalks or sit close. The following are varieties of this:

1. Spherical, *(globosum* s. *sphaericum)*, when the flowers have a perfectly round form, as in the Gomphrena *globosa*, fig. 199.

2. Roundish, *(subglobosum)*, when the head of flowers is nearly round, but where the length exceeds the breadth, as in clover, Gomphrena *globosa*.

3. Conical, *(conicum)*, when the head is long, drawing towards a point, as in Trifolium *montanum*.

4. Hemispherical, *(dimidiatum,* s. *hemisphericum)*, when the head is round on one side and flat on the other.

5. Leafy, *(foliosum)*, when the head is surrounded with leaves.

6. Tufted, *(comosum)*, having leaves at the point, as Bromelia *Ananas*.

7. Naked, *(nudum)*, when it is devoid of leaves.

8. Standing on the point, *(terminale)*, when it stands on the top of the stem.

9. Axillary, *(axillare)*, standing in the angles of the leaves, that is, where the base of the leaf, or of the leaf-stalk is placed.

10. Alar, *(alaris)*, sitting in the axillae of the branches*.

§ 30.

The Ear *(spicula* s. *locusta)* is either named from the flowers of the grasses inclosed in the glume (§ 76), or we understand by it also the flowers of the gramineous plants, such as Cyperus, Scirpus *sylvaticus*, &c. which stand closely pressed together on a filiform flower stalk. It is denominated according to the number of the flowers, and their figure.—The following are the kinds of it:

1. One-flowered, *(uniflora)*, that contains but one flower, as Agrostis.

2. Two-flowered, *(biflora)*, having two flowers, as in Aira.

3. Three-flowered, *(triflora)*, &c.

4. Many-flowered, *(multiflora)*, that contains many flowers, fig. 34, 93, 101, 291.

5. Round, *(teres)*, when the flowers in the spicula are so placed that their horizontal section is round, as Festuca *fluitans*, &c. fig 93.

* The Glomerule, *(glomerulus)* is properly a small head of a very small flower. There are two kinds of it, viz. the *axillary glomerule* (Glomerulus axillaris) which sits in the axillae of the leaves, as Amaranthus *polygonoides*; and the *lateral glomerule* (Glomerulus lateralis) which sits on the branches where formerly the leaves stood, as Bohemeria *ramiflora*. When a spike (§ 31), a raceme (§ 32), or a panicle (§ 37), is composed of glomerules, we say Spica glomerata, rancemus glomeratus, or panicula glomerata.

6. Two-ranked, *(disticha)*, when the flowers in the spicula are placed in two opposite rows on the same level, as in Cyperus, fig. 291.

7. Ovate, *(ovata)*, when the out-line of the spicula resembles the figure of an egg, as Bromus *secalinus.*

8. Oblong, *(oblonga)*, when the out-line of the spicula exhibits an ellipsis more or less perfect, fig. 34.

9. Linear, *(linearis)*, when the spicula is long and small, but of equal breadth throughout, fig. 291*.

§ 31.

The SPIKE, *(spica)*, is that sort of inflorescence where many flowers, without any foot-stalk, sit on a simple filiform principal flower stalk. If there be a foot-stalk, it must be much shorter than the flower. The kinds are;

1. Glomerate, *(glomerata)*, when the spike consists of a spherical collection of flowers.

2. Interrupted, *(interrupta)*, when the flowers upon the spike are interrupted by naked interstices.

3. Verticillated, *(verticillata)*, when the flowers, leaving naked interstices on the spike, appear on that account to be placed in whirls.

4. Imbricated, *(imbricata)*, when the flowers stand so thick together that one lies upon another.

* Many spiculae may form a spike, a raceme, or a panicle. But the flowers of the gramineous plants are often collected into a large spike, which is then properly called Spica, as Scirpus, Eriophorus, Carex, Typha, &c.

5. Distichous, *(disticha)*, when the flowers are arranged on the spike in two rows.

6. One-rowed, *(secunda)*, when the flowers are all arranged on one side of the spike, so that the other side is naked.

7. Cylindrical, *(cylindrica)*, when the spike is equally covered with flowers both above and below.

8. Linear, *(linearis)*, that is very slender, and of equal thickness.

9. Ovate, *(ovata)*, that is thick above, more slender below, and appears of an oval form.

10. Ventricose, *(ventricosa)*, thick in the middle, and slender at both extremities.

11. Leafy, *(foliosa)*, having leaves between the flowers.

12. Comose, *(comosa)*, having leaves at the apex.

13. Fringed, *(ciliata)*, having hairs between the flowers.

14. Simple, *(simplex)*, without branches, fig. 277.

15. Branched or compound, *(ramosa* vel *composita)*, when several spikes stand on one branched or divided stalk.

16. Conjugate, *(conjugata)*, when two spikes, standing on one stalk, unite at the base.

17. Bundled, *(fasciculata)*, when several spikes, standing on one foot-stalk, unite at the base.

18. Terminal, *(terminalis)*, standing on the apex of the stalk or branch.

19. Axillary, *(axillaris)*, standing in the angles at the origin of the leaves.

20. Lateral, *(lateralis)*, standing on the wood of the former year, that is, on the place now destitute of leaves.

§ 32.

The RACEME, *(racemus)*, is that sort of inflorescence to which several pedunculated flowers are longitudinally attached, nearly of equal length, or at least where the lowest flower-stalks are little longer than the upper. Here follow the different kinds of Raceme:

1. One-sided, *(unilateralis)*, when only one side of the stem is set with flowers.

2. One-rowed, *(secundus)*, when the flower-stalks are situated round the principal stem, but the flowers themselves are directed only to one side.

3. Limber, *(laxus)*, when the raceme is very pliant or flexible.

4. Stiff, *(strictus)*, when the raceme does not bend.

5. Simple, *(simplex)*, when it is unbranched, fig. 278.

6. Compound, *(compositus)*, when several single racemes unite on one stem.

7. Conjugate, *(conjugatus)*, when two racemes, standing on one stem, unite at the base.

8. Naked, *(nudus)*, without leaves or bracteae.

9. Foliate, *(foliatus)*, set with leaves or bracteae.

10. Bracteate, *(bracteatus)*, when there are bracteae at the flowers.

11. Ebracteate, *(ebracteatus)*, having no bracteae.

12. Erect, *(erectus)*, standing upright.

13. Straight, *(rectus)*, straight, without bending.

14. Cernuous, *(cernuus)*, when the apex of the raceme is bent downwards.

15 Nodding, *(nutans)*, when the half of the raceme is bent downwards.

16. Hanging, *(pendulus)*, when the raceme hangs down perpendicularly.

§ 33.

The FASCICLE, or bundle, *(fasciculus)*, is a number of simple foot-stalks of equal height, which arise at the point of the stem, not from one point, but from several. As an example of the Fasciculus may be quoted Dianthus *carthusianorum*.

§ 34.

The UMBEL, *(umbella)*, consists of a number of flower-stalks of equal length that rise from the point. In an Umbel the flower-stalks are called rays, *(radii)*. There are the following varieties of the Umbel :

1. Simple, *(simplex)*, when the rays bear but one flower.

2. Compound, *(composita)*, when each ray of the umbel supports a simple umbel, fig. 86. The rays which support the simple umbels are called the universal or general umbel, *(umbella universalis)*. The simple umbels are called the particular or partial umbels, *(umbella partialis* s. *umbellula)*.

3. Sitting, *(sessilis)*, when the umbel has no stalk.

4. Penduncculated, *(penduncculata)*, when it is furnished with a stalk.

5. Close, *(conferta)*, when the rays of the umbel stand so near one to another that the whole umbel becomes very thick and close.

6. Distant, *(rara)*, when the rays stand wide.

7. Poor, *(depauperata)*, when the umbel has but few flowers.

8. Convex, *(convexa)*, when the middle rays are high, but stand thick, so that the whole form a globular figure.

9. Flat, *(plana)*, when the rays being of equal length, the flowers form a flat surface.

§ 35.

The CYME, *(cyma)*, is that species of inflorescence where the whole at first view has the appearance of a compound umbel, only the principal flower-stalk and those which support the particular florets do not rise from the same point. The flower-stalks rise close above one another, and are divided into irregular branches. Examples of the Cyme are found in Sambucus *nigra*, and Viburnum *opulus*.

§ 36.

The CORYMB, *(corymbus)*, is, properly speaking, an erect racemus, the lower flower-stalks of which are either branched or simple, but always so much produced as to be of equal height with the uppermost, fig. 25, 266.

§ 37.

The PANICLE, *(panicula)*, consists of a number of simple flowers that stand on unequally divided branches, and on a long peduncle, fig. 34. The kinds are,

1. Simple, *(simplex)*, that has only undivided side-branches.

2. Branched, *(ramosa)*, when the branches are again branched.

3. Much branched, *(ramosissima)*, when the side-branches are much divided.

4. Disappearing, *(deliquescens)*, when the foot-stalk so loses itself in branching, that it cannot be traced to the end.

5. Spreading, *(patentissima)*, when the branches stand wide from one another, and spread out on all sides.

6. Crowded, *(coarctata)*, when the branches stand very close together.

7. One-rowed, *(secunda)*, when the branches incline all to one side.

§ 38.

The THYRSE, *(thyrsus)*, is a condensed panicle, whose branches are so thick that the whole has an oval form, as in the flower of the Privet, Ligustrum *vulgare*, Tussilago *Petasites*.

§ 39.

The SPADIX is peculiar to the palms, and some plants allied to the genus Arum. All flower-stalks that are contained in a vagina, are called Spadix. This organ is sometimes formed like a spike, racemus, or panicle, and from these it takes its name, fig. 41, 42.

The terms appropriated to it are the following,

1. Spiked, *(spicatus)*, having the appearance of a spike.

2. Raceme-like *(racemosus)* forming a raceme.

3. Paniculated, *(paniculata)*, having the form of a panicle.

§ 40.

The CATKIN, *(amentum* s. *julus)*, is a long and always simple stem, which is thickly covered with scales, under which are the flowers or their essential parts, fig. 37. Examples of this are found in the willows (Salices,) hazle, Corylus *avellana*, hornbeam, Carpinus, &c.

1. Cylindrical, *(cylindricum)*, which is equally thick above and below.

2. Attenuated, *(attenuatum)*, which grows thinner and thinner to the point.

3. Slender, *(gracile)*, which is long, but has few scales, and also is slender in proportion to its length.

4. Ovate, *(ovatum)*, which is thick below and round, but grows gradually more slender to the point.

§ 41.

The MASS *(Sorus)* is found only in the Filices which carry their flowers upon the frond. The small masses of seed-capsules found on the fronds of these plants have obtained this name. The kinds are,

1. Roundish *(subrotundus)* when the seed-capsules form a globular mass, as in Polypodium *vulgare*, fig. 15.

2. Lunated, *(lunatus)*, when the mass of seed-capsules forms a hemisphere as in Lonchitis.

3. Linear, *(linearis)* when it forms a straight line, as Asplenium, Pteris, Blechnum, &c. fig. 39. 293.

4. Two-rowed, *(biserialis)* when the seed-capsules run in two close lines, as in Danaea, Angiopteris, fig. 297 *.

5. Continued, *(continuus)*, when a linear mass proceeds without interruption, as in Pteris, Blechnum, Lindsaea, fig. 293.

6. Interrupted, *(interruptus)*, when a linear mass proceeding straight forward is often separated, as Woodwardia.

7. Longitudinal, *(longitudinalis)*, when a linear mass goes from the point of the frond to the base, as Blechnum.

8. Marginal *(marginalis)* when such a mass runs along the rim, as Pteris, Lindsaea, fig. 293.

9. Transverse *(transversus)* when such a mass stretches from the margin to the centre, as Asplenium, Meniscium, fig. 39.

§ 42.

The Leaves *(folia)* are the production and prolongation of the ascending stem; they are in gene-

* A two-rowed mass *(sorus biserialis)* and roundish two-rowed masses *(sori subrotundi biseriales)* as also linear two-rowed masses *(sori lineares biseriales)* are easily discriminated. The first shews the presence of two closely situated rows of seed capsules; the second points out roundish or a heap of roundish conglomerated masses, standing in two parallel rows, more or less distant; and the third betokens the same, only that the masses are linear.

ral membranaceous bodies, but sometimes succulent, almost always of a green colour, unfolding themselves, and sooner or later, according to their structure falling off.

They are distinguished and denominated according as they are simple or compound, according to their situation, substance, or position, their attachment or direction. Every simple leaf must be considered in respect of its apex, its base, its circumference, its margin and its two surfaces.

A. Simple Leaves.

a. *In respect of the Apex,*

A leaf is said to be

1. Acute, *(acutum),* when the leaf ends in a point, fig. 38.

2. Acuminated, *(acuminatum),* when the point is lengthened out, fig. 200.

3. Pointed, *(cuspidatum),* when the lengthened out point ends in a small bristle, fig. 198.

4. Obtuse, *(obtusum),* when the end of the leaf is blunt or round, fig. 25.

5. Mucronate, *(mucronatum),* when there is a bristle-shaped aculeus, situated on the round end of a leaf, as in the Amaranthus *Blitum.*

6. Bitten, *(praemorsum),* when the leaf is as it were bitten off at the point, forming a curved line, as in the Pavonia *praemorsa.*

7. Truncated, *(truncatum)*, when the point of the leaf is cut across by a straight line, as in the Liriodendron *tulipifera.*

8. Wedge-shaped, *(cuneiforme)*, when a truncated leaf is pointed on both sides at the base.

9. Dedaleous, *(daedaleum)*, when the point has a large circuit, but is truncated and ragged.

10. Emarginated, *(emarginatum)*, when an obtuse pointed leaf has a part as it were taken out of the apex, fig. 31.

11. Retuse, *(retusum)*, when an obtuse leaf is somewhat emarginated, but in a small degree.

12 Cleft, *(fissum)*, when there is a cleft at the point extending half way down the leaf. When there is but one cleft at the point, the leaf is called bifid, *(folium bifidum)* ; if there are two clefts, it is called trifid, *(trifidum)*, fig. 23. ; if there are more clefts, the leaf is called *quadrifidum, quinquefidum,* &c. *multifidum*, with many clefts.

13. Fan-shaped, *(flabelliforme)*, when a truncated cuneiform leaf is at the point once or oftener cleft.

14. Tridentated, *(tridentatum)*, when the point is truncated, and has three indentations.

b. *In respect of the Base.*

15. Heart-shaped, *(cordatum)*, when the base is divided into two round lobes, the anterior part of the leaf being ovate, fig. 20, 27, 203.

16. Kidney-shaped, *(reniforme)*, when the base is divided into two round separate lobes, and the anterior part of the leaf is round.

17. Moon-shaped, *(lunatum)*, when both lobes at the base have either a straight or somewhat arched line, and the anterior part of the leaf is round.

18. Unequal, *(inaequale)*, when one side of the leaf is more produced than the other, fig. 248.

19. Arrow-shaped, *(sagittatum)*, when the base is divided into two projecting pointed lobes, and the anterior part of the leaf is likewise pointed, fig. 44.

20. Spear-shaped, *(hastatum)*, when the two-pointed lobes of the base are bent outwards.

21. Ear-shaped, *(auriculatum)*, when there are at the base two small round lobes bent outwards. It is nearly the hastate leaf, only the lobes are smaller and round, fig. 292.

c. *In respect of Circumference.*

22. Orbicular, *(orbiculatum)*, when the diameter of the leaf on all sides is equal.

23. Roundish, *(subrotundum)*, differs little from the foregoing, only that the diameter is longer, either from the base to the apex, or from side to side.

24. Ovate, *(ovatum)*, a leaf which is longer than it is broad; the base is round and broadest, the apex narrowest.

25. Oval or elliptical, *(ovale* s. *ellipticum)*, a leaf whose length is greater than its breath, but round both at base and apex.

26. Oblong, *(oblongum)*, when the breadth to the length is as 1 to 3, or the breadth always least, but the apex and base vary, that is, they are sometimes obtuse, sometimes pointed.

27. Parabolic, *(parabolicum)*, a leaf is so called which is round at the base, then forms a small bend, and grows less towards the point, fig. 245.

28. Spatulate, *(spatulatum)*, when the fore part of a leaf is circular, growing smaller towards the base, as in the Cucubalus *Otites*, fig. 238.

29. Rhombic, *(rhombeum)*, when the sides of the leaf run out into an angle, so that the leaf represents a square, fig. 22.

30. Oblique, *(subdimidiatum)*, is that leaf which has one side broader than the other. Of this leaf there are several varieties, as,

a. Heart-shaped oblique, *(sub-dimidiato-cordatum)*, a heart-shaped leaf, which is at the same time oblique, as in the Begonia *nitida*, fig. 197.

b. Trapeziform, *(trapeziforme)*, a rhombic leaf, with one side smaller than the other, &c.

31. Panduraeform, *(panduraeforme)*, when an oblong leaf has a deep curve on both sides, fig. 24.

32. Sword-shaped, *(ensiforme)*, an oblong leaf, growing gradually narrower towards the apex, which is pointed; the sides are flat and have more or less of an arch-like form, as in the sword-flag, Iris.

33. Lanceolate, *(lanceolatum)*, an oblong leaf, which grows gradually narrower from the base to the point.

34. Linear, *(lineare)*, when both sides of a leaf run parallel to each other, so that it is equally broad at the base and the apex, fig. 29.

35. Capillary, *(capillare)*, when a leaf has scarcely any breadth, and is as fine as a thread or hair.

36. Awl-shaped, *(subulatum)*, a linear leaf, which is sharply pointed.

37. Needle-shaped, *(acerosum)*, a linear leaf that is rigid, and generally endures through the winter, as in the pine-tribe, Pinus.

38. Triangular, *(triangulare)*, when the circumference represents a triangle, the apex of which makes the point of the leaf, as in the birch, Betula *alba*.

39. Quadrangular, quinquangular, *(quadrangulare, quinquangulare)*, when the circumference of the leaf has 4 or 5 angles, as in the Menispermum *canadense*.

40. Intire, *(integrum* s. *indivisum)*, which is not at all cleft or divided, fig. 203.

41. Lobed, *(lobatum)*, when a leaf is deeply divided nearly half its length into lobes. According to the number of lobes it is denominated bi-lobed *(bi-lobum)*, as in Bauhinia; tri-lobed, *(tri-lobum)*, quinquelobed, *(quinquelobum)*, as in the hop, Humulus *Lupulus*, &c. fig. 32.

42. Palmated, *(palmatum)*, when there are five or seven very long lobes, that is, when the segments are more than half way divided.

43. Divided, *(partitum)*, when in a roundish leaf the division extends to the base; Ranunculus *aquatilis*.

44. Two-ranked, *(dichotomum)*, the last leaf, whose linear sections are divided or subdivided into twos.

45. Torn, *(laciniatum)*, when an oblong leaf has several irregular clefts.

46. Sinuated, *(sinuatum)*, when on the sides of an oblong leaf there are round incisures, as in the oak, Quercus *robur*, fig. 289.

47. Pinnatifid, *(pinnatifidum)*, when there are regular incisures, that go almost to the middle rib, fig. 15.

48. Lyre-shaped, *(lyratum)*, nearly the foregoing leaf, whose outer segment is very large and round, fig. 243.

49. Runcinate, *(runcinatum)*, when the incisures of a pinnatifid leaf are pointed, and form a curve behind, as in the dandelion, Leontodon *Taraxacum*, fig. 242.

50. Squarroso-laciniate, *(squarroso-laciniatum)*, when the leaf is cut almost into the middle rib, and the incisures run in every direction, as in the thistle, Carduus *lanceolatus*, fig. 265.

N. The contour of the leaves from No. 41 to 43 is round. From No. 44 to 49 it is oblong.

d. *In respect of the Margin.*

51. Quite entire, *(integerrimum)*, when the margin is without either notch or indentation, fig. 1. 2.

N. This No. 50. and No. 40. are often confounded. *An intire* leaf is merely the opposite of the numbers from 40 and 41 to 49. It may often be either dentated or serrated. A *quite intire* leaf may indeed be formed like numbers from 41 to 47, but it can have no indentations or serratures, as in the following leaves.

52. Cartilagineous, *(cartilagineum)*, when the margin consists of a border of a harder substance than the disk.

53. Undulated, *(undulatum)*, when the margin is alternately bent in and out, fig. 39, 197.

54. Crenated, *(crenatum)*, when the margin is set with small and round notches, having at the same time a perpendicular position.

55. Repand, *(repandum)*, when there are on the margin small sinuses, and between them segments of a small circle, fig. 20.

56. Toothed, *(dentatum)*, when the margin is set round with small pointed and distinctly separated teeth, fig. 32.

57. Duplicato-dentate, *(duplicato-dentatum)*, when each small tooth of the margin is again dentated, as in the elm, Ulmus *campestris*, fig. 248.

58. Dentato-crenate, *(dentato-crenatum)*, when each tooth is set with small and round denticuli.

59. Serrated, *(serratum)*, when the teeth on the margin are very sharp pointed, and stand so close that one seems to lie on the back of another.

60. Gnawed, *(erosum)*, when the margin is unequally sinuated, as if it had been gnawed, as in some species of sage, Salvia.

61. Spiny, *(spinosum)*, when the margin is set with spines, as in the thistle, Carduus.

62. Fringed, *(ciliatum)*, when the margin is set round with strong hairs, of equal length, and at a considerable distance from one another.

e. *In respect of their Surface.*

63. Aculeated, *(aculeatum)*, when the surface is covered with spines.

64. Hollow, *(concavum)*, when there is a hollow in the middle of the leaf.

65. Channelled, *(canaliculatum)*, when the middle rib of a long and narrow leaf is furrowed.

66. Wrinkled, *(rugosus)*, when the surface is raised between the veins of the leaf, and thus forms wrinkles, as in sage, Salvia.

67. Bullate, *(bullatum)*, when the parts raised between the veins on the surface appear like blisters.

68. Pitted, *(lacunosum)*, when the raised places between the veins are on the under surface, so that the upper surface appears pitted.

69. Curled, *(crispum)*, when the leaf is fuller on the margin than in the middle, so that it must lie in regular folds, fig. 35.

70. Folded, *(plicatum)*, when the leaf lies in regular straight folds from the base.

71. Veined, *(venosum)*, when the vessels of a leaf rise out of the middle rib. This is the case in most plants, fig. 2, 14, 25, 27, 245, 248, 289, &c.

72. Netwise veined, *(reticulato-venosum)* when the veins which rise from the middle rib again subdivide into branches that form a sort of net-work.

73. Ribbed, *(costatum)*, when veins arise out of the middle, and proceed in a straight line towards the margin in considerable numbers and close together, as in the Calophyllum *Inophyllum*, Canna, Pisang, Musa, &c.

74. Nerved, *(nervosum)*, when the vessels rising out of the petiolus run from the base to the apex, fig. 200, 203.

75. Three-nerved, *(trinervium)*, when three nerves take their origin from the base, fig. 100. Thus we likewise say, *quinquenervium*, *septemnervium*, fig. 203, &c.

76. Triple-nerved, *(triplinervium)*, when out of the side of the middle rib above the base there arises a nerve running towards the point, as in Laurus *Cinnamomum*, and *Camphora*, fig. 290.

77. Quintuple-nerved, *(quintuplinervium)*, when out of the middle rib, above the base, there arise two nerves running towards the point, fig. 201.

78. Septuple-nerved, *(septuplinervium)*, when on each side of the middle rib above the base three nerves arise and proceed to the apex, fig. 202.

79. Venoso-nerved, *(venoso-nervosum)*, when in a leaf having nerves, the vessels run into branches as in a veined leaf, as in the Indian cress, Tropaeolum *majus*, fig. 197, 198.

80. Streaked, *(lineatum)*, when the whole leaf is full of smooth parallel vessels that run from the base to the apex*.

81. Nerveless, *(enervium)*, when no nerves rise from the base.

* Linnaeus often calls that a *folium lineatum* which is veined, but where the veins run in pretty straight lines, and are highly raised, as in the Zizyphus *volubilis*. In some exotic plants the upper surface of the leaf differs from the under in respect of the division of the nerve, and therefore it is necessary to describe both surfaces.

82. Veinless, *(avenium)*, where there are no veins.

83. Dotted, *(punctatum)*, when instead of ribs or veins there are dots or points, as in the Vaccinium *Vitis idaea.*

84. Coloured, *(coloratum)*, a leaf of some other colour than green.

85. Cowled, *(cucullatus)*, when in a heart-shaped leaf the lobes are so bent towards each other as to have the appearance of a cone.

86. Convex, *(convexum)*, when the middle of the leaf is thicker than the rim, raised on the upper surface and hollowed on the under.

87. Keel-shaped, *(carinatum)*, when on the under surface of a linear, lanceolate, or oblong leaf, the place of the middle rib is formed like the keel of a ship.

88. Quadruply keeled, *(quadricarinatum)*, when the middle rib, by means of a thin leaf above and below, projects, and the margin is incrassated, so that a horizontal section has the appearance of a cross, as Ixia *cruciata.*

B. *Compound Leaves.*

89. Compound, *(compositum)*, when several leaves are supported by one foot-stalk. To this term belong Nos. 88, 92, 95, 96, 97. But when the leaf agrees with the above definition, although it should not come under any of the following kinds, it is still to be considered as a compound leaf.

90. Fingered, *(digitatum)*, when the base of several leaves rests on the point of one foot-stalk, as in the horse-chesnut, Aesculus *Hippocastanum.*

91. Binate, *(binatum)*, when two leaves stand by their base on the top of one stalk; but if the two foliola of a binate leaf bend back in a horizontal direction, it is called a conjugate leaf, *(folium conjugatum).*

92. Bigeminate, *(bigeminatum, bigeminum)*, when a divided leaf-stalk at each point bears two leaves, as in some species of Mimosa, fig. 217.

93. Trigeminate, *(trigeminatum* or *tergeminum)*, when a divided leaf-stalk on each point bears two leaves, and on the principal stalk, where it divides, there is a leaf at each side, as in the Mimosa *tergemina*, fig. 234.

94. Ternate, *(ternatum)*, when three leaves are supported by one foot-stalk; as in the clover, Trifolium *pratense*, strawberry, Fragaria *vesca.*

95. Biternate, *(biternatum*, s. *duplicato-ternatum)*, when a foot-stalk which separates into three, at each point bears three leaves.

96. Triternate, *triternatum*, s. *triplicato-ternatum)*, when a foot stalk which separates into three, is again divided at each point into three, and on each of these nine points bears three leaves, fig. 207.

97. Quadrinate, *(quadrinatum)*, when four leaves stand on the point of a leaf-stalk, as Hedysarum *tetraphyllum.*

98. Quinate, *(quinatum)*, when five leaves are supported by one foot-stalk: this, it is true, has some affinity with No. 88, but varies on account of the

number five, as in the other there are generally more leaves.

99. Umbellate, *(umbellatum)*, when at the point of a leaf-stalk there stand a number of leaves closely set, and forming the figure of a parasol; as Aralia *Sciodaphyllum*, Panax *chrysophyllum*.

100. Pedate, *(pedatum* s. *ramosum)*, when a leaf-stalk is divided, and in the middle where it divides there is a leafet, at both ends there is likewise a leafet, and on each side between the one in the middle and that at the end, another, or two or even three leaves. Such a leaf, therefore, consists of 5, 7, or 9 leafets that are all inserted on one side, as in the Helleborus *viridis, foetidus*, and *niger*, fig. 246.

101. Pinnated, *(pinnatum)*, where on an undivided leaf-stalk there is a series of leafets on each side and on the same plane. Of this there are the following kinds:

α. Abruptly pinnated, *(pari-pinnatum* s. *abrupte pinnatum)*, when at the apex of a pinnated leaf there is no leafet, fig. 30.

β. Pinnate with an odd one, (*impari-pinnatum*, s. *pinnatum cum impari*), when at the apex of a pinnated leaf there is a leafet.

γ. Oppositely pinnate, (*opposite pinnatum*), when the leafets on a pinnated leaf stand opposite to one another.

δ. Alternately pinnate (*alternatim pinnatum*), when the leafets on a pinnated leaf stand alternately, fig. 30.

ε. Interruptedly pinnate, (*interrupte pinnatum*), when in a pinnated leaf each pair of alternate leafets is smaller, fig. 8.

ζ. Jointedly pinnate, *(articulate pinnatum)*, when between each pair of opposite pinnulae or leafets the stem is furnished with a jointed edge, fig. 239.

η. Decursively pinnate, *(decussive pinnatum)*, when from each particular pinnula a foliaceous appendage runs down to the following one, fig. 240.

θ. Decreasingly pinnate, *(pinnatum foliolis decrescentibus)*, when the successive foliola on a pinnated leaf grow gradually smaller to the point, as in Vicia *sepium.*

102. Conjugately pinnated, *(conjugato-pinnatum)*, when a leaf-stalk divides, and each part makes a pinnated leaf, fig. 222.

103. Ternato-pinnate, *(ternato-pinnatum)*, when at the point of a principal leaf-stalk there stand three pinnated leaves, as Hoffmannseggia.

104. Digitato-pinnate, *(digitato-pinnatum)*, when several simply pinnated leaves, from four to five, stand on the point of one stalk, as in Mimosa pudica, fig. 285.

105. Doubly pinnate, *(bipinnatum, duplicato-pinnatum)*, when a leaf-stalk bears, on one plane on both sides, a number of leaf-stalks, of which each is a pinnated leaf, fig. 249.

106. Trebly pinnate, *(triplicato pinnatum*, s. *tripinnatum)*, when several doubly pinnated leaves are attached to the sides of a foot-stalk on one plane, fig. 247.

107. Doubly compound, *(decompositum)*, when a divided leaf-stalk connects several leaves; of this

kind are Nos. 90, 91, 93, 98, 99, 100. But the term *decompositum* is only used when the division of the leaf-stalk and of the pinnulae is irregular, fig. 241.

108. Super-decompound, *(supra decompositum)*, when a leaf-stalk, which is often divided, sustains several leaves; to this belong No. 94, 101. But then the term is used only when the divisions of the leafets are either more numerous or not so regular.

C. *In respect of the Place.*

109. Radical, *(radicale)*, when a leaf springs from the root, as in the violet, Viola *odorata*, Sagittaria *sagittifolia*, fig. 44.

110. Seminal, *(seminale)*, when a leaf grows out of the parts of the seed, as in the hemp, where, as soon as it springs, there appear two white bodies, which are the two halves of the seed, that change into leaves.

111. Cauline, *(caulinum)*, which is attached to the principal stem. The root-leaves and stem-leaves of a plant are often very different.

112. Rameous *(rameum)*, when a leaf rises from the branches.

113. Axillary, *(axillare* v. *subalare)*, which stands at the origin of the branch.

114. Floral *(florale)*, which stands close by the flower, fig. 33.

D. *In respect of Substance.*

115. Membranaceous, *(membranaceum)*, when both membranes of a leaf lie close upon one ano-

ther without any pulpy substance between them, as in the leaves of most trees and plants.

116. Fleshy, *(carnosum)*, when between the membranes there is much soft and pulpy substance, as in houseleek, Sempervivum *tectorum*.

117. Hollow, *(tubulosum,)* when a somewhat fleshy and long leaf is hollow, as in the onion, Allium *Cepa*.

118. Bilocular, *(Biloculare)*, when in a linear leaf, internally hollow, the cavity is divided by a longitudinal partition into two; as Lobelia *Dortmanna*.

119. Articulate, *(articulatum* s. *loculosum)*, when a cylindrical hollow leaf has its cavities divided by horizontal partitions, as Juncus *articulatus*.

120. Cylindrical, *(teres,)* when it is formed like a cylinder.

121. Compressed, *(compressum,)* when a thick leaf is flat on both sides.

122. Two-edged, *(anceps)*, when a compressed leaf is sharp on both edges.

123. Depressed, *(depressum)*, when the upper surface of a fleshy leaf is pressed down, or as it were hollowed out.

124. Flat, *(planum)*, when the upper surface of a thick leaf forms an even plane.

125. Gibbous, *(gibbosum* s. *gibbum)*, when both surfaces are convex.

126. Scimitar-shaped, *(acinaciforme)*, a two-edged thick leaf, on one side sharp and arched, on the other, straight and broad, fig. 232.

127. Axe-shaped, *(dolabriforme)*, when a fleshy leaf is compressed, circular on the upper part, con-

vex on the one side, sharp-edged on the other, and cylindrical at the base, fig. 244.

128. Tongue-shaped, *(linguiforme)*, when a long compressed leaf ends in a round point.

129. Three-sided, *(triquetrum)*, when the leaf is bounded by three narrow sides, and is at the same time long.

130. Deltoid, *(deltoides)*, when a thick leaf is bounded by three broad surfaces, and is at the same time short, fig. 231.

131. Four-cornered, *(tetragonum)*, when a leaf, long in proportion, is bounded by four narrow surfaces, as in the Pinus *nigra*.

132. Warty, *(verrucosum)*, when short, fleshy leaves are truncated, and stand in thick heaps, as in some Euphorbiae, fig. 228.

133. Hook-shaped, *(uncinatum)*, when a fleshy leaf is flat above, compressed at the sides, and bent back at the point, fig. 230 *.

E. *In respect of Situation and Position.*

134. Opposite, *(folia opposita)*, § 18; No. 12; fig. 32.

135. Dissimilar *(disparia)*, when of two leaves placed opposite the one is quite differently formed from the other; as some species of Melastoma.

136. Alternate, *(alterna)*, § 18; No. 11; fig. 23.

137. Scattered, *(sparsa)*, when the leaves stand thick on the stem, without any order.

* All these leaves, from Nos. 120 to 133, are thick and fleshy; only Nos. 117, 119, 128, 129 and 131, are sometimes in certain plants membranaceous.

138. Crowded, *(conferta* s. *approximata)*, when the leaves stand so close together that the stem cannot be seen.

139. Remote, *(remota)*, when the leaves are separated on the stem by certain interstices.

140. Three together, *(terna)*, when three leaves stand round the stem : there are sometimes four, five, six, seven, eight, &c. *quaterna, quina, sena, septena, octona*, &c.

141. Star-like, *stellata* s. *verticillata)*, when several leaves stand round the stem at certain distances, as in ladies bed-straw, Galium, &c. fig. 29.

142. Tufted, *(fasciculata)*, when a number of leaves stand on one point, as in the larch, Pinus *Larix*, Celastrus *buxifolius*, fig. 14.

143. Two-rowed, *(disticha)*, when leaves are so placed on the stem that they stand on one plane, as in the pitch fir, Pinus *picea*, Lonicera *symphoricarpos*.

144. Decussated, *(decussata)*, when the stem its whole length is set round with four rows of leaves, and at each branch, when one looks perpendicularly down upon it, the leaves seem to form a cross, as in Veronica *decussata*.

145. Imbricated, *(imbricata)*, when one leaf lies over another as the tiles upon a roof, fig. 229. Of this there are the following kinds.

α. Bifariously imbricated, *(bifariam imbricata)*, when the leaves are so laid upon one another that they form but two rows longitudinally on the stem.

β. *Trifariam imbricata*, three rows.

γ. *Quadrifariam imbricata*, &c. four rows, &c.

F. *In respect of Insertion.*

146. Petiolated, *(petiolatum)*, when a leaf is furnished with a foot-stalk.

147. Palaceous, *(palaceum)*, when the foot-stalk is attached to the margin.

148. Peltated, *(peltatum)*, when the foot-stalk is inserted into the middle of the leaf, fig. 1.

149. Sessile, *(sessile)*, when the leaf is attached to the stem without any foot-stalk, fig. 29.

150. Loose, *(Solutum*, s. *basi solutum)* a succulent cylindrical or subulate leaf, which seems to have no connection with the stalk on which it rests, but seems to hang the more loosely, as Sedum *album*.

151. Riding, *(equitans)*, a sword-shaped or linear leaf that forms at its base a sharp and deep furrow whose surfaces lie on one another and embrace the stalk, as Dracaena *ensifolia*, Sisyrinchium *striatum*, &c.

152. Decurrent, *(decurrens)*, when the foliaceous substance of a sessile leaf runs down along the stem.

153. Embracing, *(amplexicaule)*, when a sessile leaf is heart-shaped at the base, and with both lobes embraces the stem.

154. Connate, *(connatum)*, when opposite, and sessile leaves are joined at their base.

N. A perfoliated leaf, *(folium perfoliatum)*, is already described in § 18, No. 59.

G. *In respect of Direction.*

155. Appressed, *(adpressum)*, when the leaf turns up and lays its upper surface to the stem.

156. Erect, *(erectum* s. *semiverticale)*, when the leaf is directed upwards, and makes, with the stem, a very acute angle.

157. Vertical, *(verticale)*, which stands quite upright, and thus makes with the horizon a right angle.

158. Bent sideways, *(adversum)*, when the margin of a vertical leaf is turned towards the stem.

159. Spreading, (*patens*), which goes off from the stem in an acute angle.

160. Bent in, (*inflexum* s. *incurvum*), when an upright leaf is bent in at its point towards the stem.

161. Oblique, (*obliquum*), when the base of the leaf stands upwards, and the point is turned towards the ground.

162. Horizontal, (*horizontale*), when the upper surface of the leaf makes with the stem a right angle.

163. Bent down, *reclinatum* s. *reflexum*), when the leaf stands with its point bent towards the earth.

164. Bent back, (*revolutum*), when the leaf is bent outwards, and its point from the stem.

165. Hanging down, (*dependens*), when the base is turned to the zenith, and the point towards the ground.

166. Rooting, (*radicans*), when the leaf strikes roots.

167. Swimming, (*natans*), when the leaf swims on the surface of water, as in Nymphaea *alba.*

168. Immersed, (*demersum*), when the leaves are found under water.

169. Emerging, (*emersum*), when the leaf of an aquatic plant raises itself out of the water.

§ 43

The leaves of the Musci frondosi are constantly simple, never compound or divided; they are all sessile except one genus from South America and as far as is known they are always membranaceous. They are distinguished according to their outline, and may be known by the foregoing denominations. There is only one kind that it is necessary here to mention, namely,

Hair-bearing (*piliferum*) having a hair at the apex; as Polytrichum *piliferum*.

In the descriptions of LEAVES, it is to be remarked that when a leaf does not perfectly answer to the figure it comes nearest to, the word *sub* is to be used, e. g. *subcordatum*, *subovatum*, *subserratum*, &c. a nearly heart-shaped leaf, an almost ovate leaf, a leaf somewhat serrated, &c. When the leaf answers the description, but seems to be inverted, that is, that the apex resembles what the base should be, and the base is like what the apex should be, we use the word *ob*, e. g. *obovatum*, fig. 14. *obcordatum*, *&c.*

With regard to the particular parts of leaves, we have still to notice,

1. The lobe, (*lobus*), the segment of a leaf which is round at the apex, as in Acer.

2. The segment, (*lacinia*), the segment of a leaf that runs into an angle at the point, and is uneven.

3. The leafet, *(foliolum)*, the little leaves that make part of a digitated, quinate, &c. leaf, are called *foliola* or leafets.

4. The leaf of a bi-pinnated leaf, *(pinna)*, each simply pinnated leaf of a bi-pinnated leaf is called pinna.

5. The leafet of a pinnated leaf, *(pinnula)*, means one of the leafets of which the pinnated leaf is composed.

6. Two-paired pinnated, *(pinnatum bijugum)*, when the pinnated leaf has only two pair of opposite leaves, *(trijugum)*, when it has three pair, *(quadrijugum)*, when it has four pair, &c.

7. Angle, *(angulus)*, respects the point of a lacinia or segment.

8. Indentation, *(sinus)*, respects the hollow interstice between the segments of the leaf when it is round.

Each of these parts is, in accurate description, to be considered as a single leaf, in respect of surface, margin, apex, base *, &c.

§ 44.

The FROND, *(frons)* is proper to the Palms, Fili-

* In a simply pinnated leaf each leafet is called *pinnula*, or sometimes *foliolum*; and only in doubly pinnated leaves do we observe the differences marked above in Nos. 4 and 5. Linnaeus, in some species of the genus Mimosa, which have doubly pinnated leaves, calls each simply pinnated leaf of a doubly pinnated one, *pinna partialis*, and each leafet, *pinna propria*, or simply *pinna*.

ces, Musci hepatici and Algae. Its characters are, that the stalk and the leaves on it are so intimately connected, that it is difficult to determine where the one begins or the other ends. In some plants the leaves and stem so run into one another, that it is impossible to say which is the principal part.

The Palms have a simple stem (§ 16), clothed with leaves only at top. In common language we call the leaf of a Palm, a palm-branch; but it is to be considered rather as a single leaf than as a branch. The kinds are,

1. Fan-shaped, *(flabelliformis)*, when at the apex of the Stipe (§ 21) either a number of leaves spread out in a circle, or the foliaceous substance is a round flat expansion with many regular folds. Between the segments or leaves there is often a thread as in Chamaerops, Borassus.

2. Peltated, *(peltata)*, when at the apex of the Stipe the flat foliaceous substance is perfectly close, so that there is no section even in the base, as Corypha.

3. Pinnated *(pinnata)*, the frond having the appearance of a pinnated leaf; (§ 42, No. 101), as Phoenix.

4. Bipinnated, *(bipinnata)*, the frond having the appearance of a doubly pinnated leaf (§ 42. No. 105.), as Caryota.

The Filices and plants allied to them have in their fronds all the appearances by which leaves are distinguished (§ 42.) besides the following, viz.

1. Pinnated with confluent foliola, *(pinnata pinnis confluentibus)*, when it is pinnated, but the foliola are all united at the base, fig. 298.

2. Doubly pinnated, *(bipinnatifida)*, when in a pinnated frond the foliola are cleft half way down, fig. 305.

3. Quadruply pinnated, *(quadruplicato-pinnata)*, when a pinnated stipe has at each branch a trebly pinnated leaf, (§ 42. No. 106.)

4. Quintuply pinnated, *(quintuplicato-pinnata)*, when a pinnated stipe has at each branch a quadruply pinnated leaf.

5. Unfertile, *(sterilis)*, the frond which bears neither flowers nor fruit, as Blechum *spicant*, fig. 305.

6. Fertile, *(fructificans)*, bearing flowers or fruits, as Blechnum *spicant*, fig. 305.

7. Whirled, *(verticillata)*, when the leaves and stipe are not to be distinguished, and the branches of the frond are in whirls, as Equisetum.

The Musci hepatici, in respect of their fronds, have nothing remarkable, and all their varieties are discriminated by the same terms which are applied to the leaves of other plants; except the genus Riccia, where the frond is spread on the ground in the form of a star, *(stellata)*. The Algae, on the contrary, as their leaves and stipe run into one another, have a number of terms peculiar; such as,

1. Foliaceous, *(foliacea)*, when the frond is divided into greater or less sections or folds, Lichen *saxatilis, fraxineus, pulmonarius, stellaris*, fig. 3.

2. Gelatinous, *(gelatinosa)*, when the frond is diaphanous, and of the consistence of jelly; as, Lichen *crispus, fascicularis.*

3. Leathery, *(coriacea)*, when the frond is thick and tough, as Peltidea *canina*, fig. 226.

4. Imbricated, *(imbricata)*, when the foliola or sections of the frond, lie over one another like the tiles of a roof, as Lichen *parietinus, crispus.*

5. Umbilicated, *(umbilicata)*, when a round expanded frond is fixed to the body on which it grows by a process projecting from the centre of its under surface.

6. Orbicular, *(orbiculata* s. *stellata)*, when a frond is spread out in form of a circle, as Lichen *saxicola, parietinus, stellaris*, fig. 3.

7. Crustaceous, *(crustacea)*, when the frond is composed of small crusts lying on one another, as Lichen *saxicola, subfuscus*, ; Opegrapha *pulverulenta.*

8. Powdery, *(pulverulenta)*, when it consists of particles easily rubbed off and not very closely set, as Lepra.

9. Thread-like, *(filamentosa)*, when it is composed of threads, as Lichen *jubatus*, Conferva, Ceramium, Byssus.

10. Simple, *(simplicissima)*, when it is not divided, as Ceramium *filum*, Fucus *saccharinus.*

11. Shrub-like, *(fruticulosa)*, when it is branched, more or less filamentous and firm, as Lichen, *rangiferinus, uncialis.*

12. Cup-bearing, *(pyxidata* s. *scyphifera)*, when it has the appearance of a cup, as Lichen *pyxidatus, gracilis*, fig. 304 *.

§ 45.

Under the name of PROPS, *(fulcra)*, we understand those parts which differ from the stem, leaves, root and flower; but serve for keeping the plant erect, for its cloathing, defence, or other purposes. Such are the following: Stipula, Ramentum, Bractea, Vagina, Spatha, Ochrea, Ascidium, Ampulla, Ligula, Involucrum, Volva, Annulus, Pileus, Cyphella, Indusium, Cirrhus, Gemma, Peridium, Propago, Gongylus, Glandula, Spina, Aculeus, Arista, Pilus.

§ 46.

STIPULES, *(Stipulae)*, are small leaves that appear on the stem in place of the foot-stalks of the leaves. They are sometimes of a quite different shape from the proper leaves, but sometimes no way different, except in situation and size. They may be distinguished by the following terms:

1. Double, *(geminae)*, when two are present, which always stand opposite, fig. 27, 30, 32.

2. Solitary, *(solitariae)*, when a single stipule stands upon one side of the leaf foot-stalk.

3. Lateral, *(laterales)*, when they stand at the origin of the petiolus, fig. 27, 30, 32.

* The leaves of the Lemna must also be called fronds, as they are connected with the root in a particular manner, and the flowers sit upon them.

4. Under the petiolus, *(extrafoliaceae)*, when they stand somewhat under the origin of the petiolus.

5. Above the petiolus, *(intrafoliaceae)*, when they stand somewhat above the origin of the petiolus.

6. Opposite to the petiole, *(oppositifoliae)*, when in leaves placed alternately these stipulae stand in the place of the origin of the petiole, but on the other side of the stem.

7. Caducous, *(caducae)*, when they fall off soon after their evolution, as in the hazle, Corylus *Avellana.*

8. Deciduous, *(deciduae)*, when they fall off a short while before the leaves, or a considerable time after their appearance.

9. Abiding, *(persistentes)*, when they fall or wither along with the leaves, or after them*.

§ 47.

The RAMENT, *(ramentum)*, is a small, often bristle-shaped leafet, that is oblong, thin, and more or less of a brown colour ; sometimes placed, like the stipula, in the angles of the petiole, but sometimes likewise, without any order, on the stem. It appears on

* In form, the stipulae are very different, and what we have said with regard to that of the proper leaves may be applied to them, in respect of outline, apex, base, margin, and surface. They are in general sessile, *(sessiles)*, seldom connate, *(connatae)*, and still seldomer petiolated, *(petiolatae* s. *pedicellatae)*. They are often marked with a dark brown spot, as in Vicia *sativa*, and then they are called *sphacelatae*. In the genus Jungermannia the foliola which lie under the leaves are called *Auriculae*. But those which sit upon the principal stem are called *Stipulae*.

all trees when their buds open, and falls soon after. On the oak fig. 289, it stands like the stipulae; on the Scots fir, Pinus *sylvestris*, it is soon dispersed.

When the stem of a plant is covered with fine dry scales, that have the appearance of the Ramentum, it is properly called a ramentaceous stem, *caulis ramentaceus*, (§ 18. No. 55.)

§ 48.

The FLORAL LEAVES, *(bracteae)*, are leaves that stand near or between the flowers, and in general are of a different shape and colour from the other leaves, fig. 33, 44. They differ in respect of duration like the stipulae, that is, they are either caducous, deciduous, or persistent. The lime tree, Tilia *europaea*, affords an excellent example of the Bracteae. When they are of another colour than green, they are said to be coloured, *(coloratae)*. On the top of many flowers there are several of these bracteae, in which case they are called a tuft, *(coma)*. Examples of this we have in the crown imperial, Fritillaria *imperialis*, the pine apple, Bromelia *Ananas*, &c.

§ 49.

The SHEATH, *(vagina)*, is the prolongation of a leaf, which rolls itself round the stem, and thus forms a cylinder, to the opening of which the leaf is attached, as in Polygonum, and all the Grasses. When this sheath is very short, and on the upper part of it there is nothing remarkable, it is called a sheathing leaf, *(folium vaginatum)*. The vagina is also described according to its surface, § 6.

§ 50.

The SPATHE, *(spatha)*, is an oblong leaf, which surrounds the stem with its base, and serves for a covering to flowers before they blow ; but after the flowers are unfolded it stands at a greater or less distance from them. It is common to all palms, to most lilies and arums. Of it there are the following kinds :

1. Univalve, *(univalvis)*, when it consists but of one leaf, as in Arum *maculatum*, fig. 41.

2. Bivalve, *(bivalvis)*, when two leaves stand opposite to each other, as in the fresh-water soldier, Stratiotes *aloides*.

3. Vague, *(vague)*, when there is not only a large common vagina, but likewise separate vaginae for each particular division of the flower-stem, and for each particular flower.

4. Halved, *(dimidiata)*, the same with univalve, only the flowers are covered but on one side.

5. One-flowered, two-flowered, &c. many-flowered, *(uni-bi-multiflora)*, when it includes one or more flowers.

6. Withering, *(marcescens)*, when it withers at flowering, or a short while before.

7. Permanent, *(persistens)*, when it remains unchanged till the fruit ripens.

§ 51.

The ROLL, *(ochrea)*, is a leaf-like body, which surrounds the branches of the flower-stalk in some grasses, in the manner of a cylindrical sheath. This is chiefly to be observed in the genus Cyperus, fig. 291. The margin of it is various, and affords the following diversities:

1. Truncated, *(truncata)*, when the margin is even, as if it had been cut off.

2. Oblique, *(obliqua)*, when the margin is somewhat lengthened out on one side.

3. Foliaceous, *(foliacea)*, when the roll ends in a short, linear, or subulated leaf.

It is further distinguished according to its furface, as in § 6.

§ 52.

The BOTTLE, *(ascidium)*, is a particular foliaceous body that is cylindrical and hollow, and often has its mouth furnished with a complete cover, which opens occasionally. This body generally contains pure water. It is either sitting, *(sessile)*, or supported on a foot-stalk, *(petiolatum)*, and is situated at the extremity of a leaf. The latter is found in the Nepenthes *destillatoria*, fig. 28, the former in Sarracenia.

In two genera, namely the Ascium and Ruyschia, there are bracteae which have the appearance of an Ascidium, and are therefore called *Bracteae ascidiformes*, fig. 117, 121. Similar bracteae are to be found in the genus Marcgrafia.

§ 53.

The BLADDER, *(ampulla)*, is a round, hollow, closed body, that is found at the roots of some water-plants, as Utricularia, Aldrovanda, &c. fig. 288.

In maritime plants, as in Fucus, these ampullae have sometimes a singular form, which formerly gave rise to the opinion that they were the fruit of the plant.

§ 54

The STRAP, *(ligula)*, is a membranaceous, small, transparent leafet, which is situated on the margin of the vagina, and at the base of the leaf. It is only proper to the Grasses, fig. 26. It affords the following varieties:

1. Intire, *(integra)*, when it has no segments.
2. Bifid, *(bifida)*, when it is divided at the apex.
3. Torn, *(lacera)*, when it is irregularly, as it were, torn on the margin.
4. Fringed, *(ciliata)*, when the margin is set with short, projecting hairs.
5. Truncated, *(truncata)*, when the upper part terminates in a transverse line.
6. Pointed, *(acuta)*, that has a short acute point.
7. Acuminated, *(acuminata)*, that has a long projecting point.
8. Very short, *(decurrens)*, that is hardly visible, and runs down the inside of the vagina.

§ 55.

The INVOLUCRE, *(involucrum)*, consists of several leaves that differ in form from the proper leaves of the plant; they surround one or several flowers and enclose them before they unfold. The involucrum is particularly found in the umbelliferous plants, § 34. There are several varieties of it, viz.

1. Common, *(universale)*, which encloses all the flower-stalks, fig. 36.

2. Partial, *(partiale)*, which encloses the partial umbels only.

3. Halved, *(dimidiatum)*, which surrounds only half of the stem.

4. Hanging, *(dependens)*, when all the leafets hang down, as in Aethusa *Cynapium.*

5. Two, three, four, or many leaved, *(di, tri, tetra,* or *polyphyllum)*, that consists of two or more leafets*.

§ 56.

The FUNGI differ so much in external appearance from other plants, that their parts cannot be compared with them. The principal parts are tne Volva, Annulus and Pileus.

The WRAPPER, *(volva)*, is a thick, and, in general, fleshy membrane, that envelopes the fungus in its young and unexpanded state, and when it is full grown remains close upon the ground. It has been

* The Involucrum has sometimes the appearance of a Calyx, § 74, and then is said to be calyciform, *(calyciforme)*, as in the liverwort, Anemone *Hepatica*. The flower-stalk, § 25, in some species of this genus, as in Anemone *pratensis*, is surrounded by an Involucrum, and is then called *pedunculus involucratus.*

considered as a part of the flower, but erroneously. In some fungi, as in the puff-ball, Lycoperdon *stellatum*, fig. 7. it is deeply cut, and is then called star-like, *(stellata)*; in others it is double, *(duplex)*.

§ 57.

The RING, *(annulus)*, is a thin membrane that is attached to the stalk, and encompasses it like a ring. When the fungus is young, this membrane is connected with the pileus, but afterwards separates from it. There are the following varieties of the annulus.

1. Upright, *(erectus)*, when the ring is fixed below, but free above, fig. 4.

2. Inverted, *(inversus)*, when the ring is fixed above, but free below, so that it is bell-shaped and hangs down, as in Agaricus *mappa*.

3. Sitting, *(sessilis)*, when, as in the above species, it is always attached by one side.

4. Moveable, *(mobilis)*, when the ring can be pushed up and down, as in Agaricus *antiquatus*.

5. Permanent, *(persistens)*, when it is found during the whole existence of the fungus.

6. Fugacious, *(fugax)*, when at the perfect developement of the fungus the ring disappears.

7. Cobweb-like, *(arachnoideus)*, when the ring is composed of a very white web. Rings of this kind are often evanescent*.

* The Ring is properly a prolongation of the membrane of the pileus, part of which remains upon the stalk; but in some fungi it does not separate from the rim of the pileus, but from the stalk, and remains attached to the pileus, in longer or shorter portions according to the species. In this case it is called *cortina*.

§ 58.

The CAP, *(pileus)*, is the top of the fungus, in general shaped like a plate or bonnet, and supported by the stalk, *(stipes)*. In this body are situated the organs of generation. There are the following kinds of it.

1. Flat, *(planus)*, forming a plane expansion, fig. 223, 224 and 225.

2. Round, *(convexus)*, which is convex above.

3. Hollow, *(concavus)*, where there is a depression on the upper surface, fig. 6.

4. Bossed, *(umbonatus)*, when there is a prominent point in the centre, fig. 4.

5. Bell-shaped, *(campanulatus)*, when it is very convex above, and spreads wide below like a bell, as in Agaricus *fimetarius*.

6. Viscid, *(viscidus)*, when the upper surface is covered with a clammy exudation.

7. Scaly, *(squamosus)*, when it is covered above with many imbricated scales of a different colour from its own, as in Agaricus *muscarius*.

8. Squarrose, *(squarrosus)*, when the scales stand up from the surface, fig. 4.

9. Halved, *(dimidiatus)*, when it forms only half the figure of a plate, and appears to have one side taken off; as in Hydnum *auriscalpium*.

10. Stipitate, *(stipitatus)*, when it is supported by a stalk, § 21.

11. Sitting, *(sessilis* s. *acaulis)*, when it is not supported by a stalk.

The pileus of the fungi has likewise parts peculiar to it, which must be carefully observed, such as the *Umbo, Lamella, Porus, Aculeus* s. *Echinus* and *Papillae.*

α. The boss, *(umbo)*, is the centre of the pileus, which is somewhat raised. This umbo is often present, even in a concave pileus.

β. The gills, *(lamellae)*, are the thin foliaceous membranes on the underside of the mushroom. The gills contain the capsules of the seed, and are peculiar to the genus Agaricus. fig. 225. The Lamellae are,

a. Equal, *(aequales)*, when all the gills reach from the stalk to the margin.

b. Unequal, *(inaequales* s. *interruptae)* when some reach from the stalk to the rim, while others go only half way, either from the stalk or from the rim.

This inequality of the gills is distinguished into

a. Two-rowed, *(biseriales)*, when a long and short gill are alternate.

b. Three-rowed, *(triseriales)*, when two short gills stand between two long ones.

c. Branched, *(ramosae)*, when several gills unite in one.

d. Decurrent, *(decurrentes)*, when the gills run down the stalk.

e. Venous, *(venosae)*, when the gills are so small that they appear to be only raised veins, as in Agaricus *chantarellus.*

γ. The pores, *(pori)*, when on the under side of the pileus there are very small holes, as if made with the point of a needle, fig. 223. These are peculiar to the Boleti.

δ. The prickles, *(aculei* s. *echini)*, are raised projecting points, in which, as in the pores, are contained the organs of generation. They are peculiar to the genus Hydnum, fig. 224.

ε. The warts, *(papillae)*, are small, round protuberances that appear on the under surface, and likewise contain the organs of generation *.

§ 59.

The LITTLE CUP, *(Cyphella)*, is a peltated concavity with a raised rim, which is found on the under side of some Algae; as Lichen *sylvaticus*.

§ 60.

The ENVELOPE *(Peridium)*, is a thin membrane of some fungi (Gasteromyci) separating in various ways, under which lie the seeds or seed-bearing bodies; as Lycoperdon, Trichia, Stemonites, Nidularia, &c. Of this we have the following kinds:

1. Simple *(simplex)*, when it consists of a simple membrane as Physarium, Nidularia, &c.

2. Double, *(duplex)*, when it consists of two superincumbent membranes, as Diderma.

* Some fungi have a very different appearence; some want the pileus, or are of a singular form without stalk. Their figure must therefore be described, as whether they are round, *(globosus)*, fig. 7, cup-shaped *(cyathiformis* s. *scyphiformis)*, fig. 284, &c.

3. Not torn, *(non dehiscens)*, when the envelope is never rent.

4. Torn, *(dehiscens)*, when it parts in pieces.

5. Irregularly torn *(irregulariter dehiscens)*, that is torn asunder in various ways and in unequal pieces.

6. Circularly torn *(circumscissum)*, that is torn equally round, so that the upper part is separated from the under part like a lid; as, Arcyria, fig. 301, 302.

7. Longitudinally cleft *(longitudinaliter fissum)*, that is torn from the top to the base in a straight line; as Dictydium.

8. Dentated, *(dentato-dehiscens)*, when the upper part bursts and the margin of the rest appears to be dentated; as, Aecidium.

9. Reticulate, *(reticulatum)*, when the envelope is pierced with small holes, and has the appearance of a net; as, Dictydium.

§ 61.

The COVER, *(indusium)*, is a tender membrane which surrounds the *sorus* (§ 41), in the Filices, and is rent on the ripening of the seed-capsules.

It presents the following kinds:

1. Flat, *(planum)*, when the thin membrane lies flat upon the seeds, as in Polypodium.

2. Peltated, *(peltatum)*, when this thin membrane is circular; and below, in the middle, is attached to the seeds by a small thread.

3. Horn-like, *(corniculatum)*, when this thin membrane is cylindrical and hollow, and incloses the flowers and seeds, as in Equisetum. In fig. 11,

there are four of these horn-like indusia to be observed*.

4. Bottle-shaped, *(urceolatum)*, which has the appearance of an almost cylindrical cup; as, Trichomanes.

5. Bivalve *(bivalve)*, which separates into two parts, and has the appearance of the last; as, Hymenophyllum.

6. Scale-like *(squamiforme)*, having the appearance of scales.

7. Continuous *(continuum)*, that proceeds uninterruptedly along a produced sorus; as, Pteris, Blechnum, fig. 293.

8. Superficial, *(superficiarium)*, that consists of the superior membrane of the leaf; as, Scolopendrium.

9. Marginal, *(marginale)*, consisting of the membrane of the margin of the leaf; as, Adiantum, fig. 293.

10. Parting outwards *(exterius dehiscens)*, that loosens itself from the margin of the leaf; as, Asplenium.

11. Parting inwards *(interius dehiscens)*, that parts from the middle rib; as, Adiantum.

12. Simple *(simplex)*, a single cover which invests the Sorus; as, Pteris, Asplenium, Adiantum.

13. Double *(duplex)*, when on each side of the

* The celebrated Dr. Smith of London has well distinguished the genera of the Filices by the way in which the indusium bursts.

Sorus there is a cover; as, Lindsaea, Scolopendrium, Dicksonia, fig. 39.

§ 62

The TENDRIL, *(cirrhus)*, is a filiform body, which serves for attaching plants to some support. Climbing plants, *(vegetabilia scandentia)*, are furnished with these. They are in general spiral, as in the Vine, Vitis *vinifera*, fig. 27. The species are as follows:

1. Axillary, *(axillares)*, when they rise from the axillae of the leaves, fig. 27.

2. Foliar, *(foliares)*, when they spring out of the points of the leaves.

3. Petiolar, *(petiolares)*, when the cirrhi stand on the point of the common foot-stalk of a compound leaf, as in Vicia.

4. Peduncular, *(pedunculares)*, when they rise out of the foot-stalk of the flower.

5. Simple, *(simplex)*, when a cirrhus is not divided.

6. Two, three, many-branched, *(bi, tri, multifidus)*, when a cirrhus branches out into two, three, or more parts.

7. Convolute, *(convolutus)*, when the cirrhus regularly winds itself round a prop.

8. Revolute, *(revolutus)*, when the cirrhus winds itself irregularly, sometimes to this side, sometimes to that *.

* When a simple leaf has a cirrhus at its apex, it is called *folium cirrhosum*, as in Gloriosa *superba*, Flagellaria *indica*, &c. When a pinnated leaf has a cirrhus at its apex as in most leguminous plants, it is called *folium pinnatum cirrhosum*, No. 3.

§ 63.

The BUD, *(gemma)*, is that part of a plant which contains the embryo of the leaves and flowers. All plants are not furnished with buds, but only such as grow in cold climates. They either inclose leaves alone, *(foliiferae)*; or leaves and flowers in separate buds, *(foliiferae et floriferae distinctae)*; or leaves and female flowers, *(foliiferae et floriferae femineae)*; or leaves and male flowers, *(foliiferae et floriferae masculae)*: or leaves and hermaphrodite flowers, *(foliiferae et floriferae hermaphroditae)*: or lastly, leaves and flowers in one bud, *(foliifero-floriferae)*. The opening of the buds, and the appearance of the leaves, is called Foliation, *(foliatio)*. This is occasioned by the fall of the outer covers, which consist of small imbricated scales. In plants that have no buds, the foliation takes place immediately from the bark. In different plants at foliation, the young leaves are variously folded up. When an opening bud is cut over horizontally, the following varieties appear:

1. Involute, *(involuta)*, when the edges of the leaves are turned in, as in the hop, Humulus *lupulus*, fig. 251, 259, 260.

2. Revolute, *(revoluta)*, when the edges of the leaves are rolled outwards, as in the willows, *(Salices)*, fig. 252, 262.

3. Obvolute, *(obvoluta)*, when two simply closed leaves, without being rolled, embrace the half of each other, as in sage, Salvia *officinalis*, fig. 256.

4. Convolute, *(convoluta)*, when the leaves are rolled up spirally, as in the plumb, Prunus *domestica*, apricot, Prunus *armeniaca*, fig. 250, 258.

5. Riding, *(equitans)*, when several leaves which lie parallel, embrace the whole of one another, as in the lilac, Syringa *vulgaris*, fig. 254, 255, 263, 264.

6. Conduplicate, *(conduplicata)*, when the sides of the leaves lie parallel to one another, as in the beech, Fagus *sylvatica*, fig. 253.

7. Plaited, *(plicata)*, when the leaves are regularly folded, as in the birch, Betula *alba*, fig. 257.

8. Bent down, *(reclinata)*, when the points of the young leaves hang down, as in Arum, Aconitum.

9. Circinal, *(circinata)*, when the whole leaf, from the point to the base, is rolled up, so that the outside is within, and the inside without, as in all the Filices, fig. 15.

N. When the leaves are opposite, the figure is often doubled, as in fig. 258, 259, 268, 262.

With regard to figure, the bud is very various, but the varieties are easily discriminated; the following kinds however may be distinguished:

1. Simple *(simplex)*, when the bud stands solitary as in most trees and shrubs.

2. Aggregate *(aggregata)*, when a number stand close together as in Zanthoxylum *fraxineum.*

3. Sessile, *(sessilis)*, when they sit close upon the branch or stem, as in most shrubs and trees.

4. Stalked, *(pedicellata)*, when it is supported on a short foot-stalk, as in Alnus.

§ 64.

The MOSS-BUD, *(propago)*, is a roundish or longish body, proceeding from the mother plant, and becoming itself a new one, as in the mosses. Linnaeus considers this as the seed. In the Musci hepatici this organ is spherical. The Marchantia bears a small cup, *(scyphus)*, in which the propago is contained.

§ 65.

The KNOT, *(Gongylus)*, is a round, hard body, which falls off upon the death of the mother-plant, and becomes a new one. An example of this is observed in the Fuci.

§ 66.

A GLAND, *(glandula)*, is a round body that serves for transpiration and secretion. The glands are generally situated on the leaves or stem. They are,

1. Sitting, *(sessiles)*, when they sit close upon the leaf, as in Cassia *marylandica*.

2. Petiolate, *(petiolatae)*, when they are raised upon a little stalk, as in the sun-dew, Drosera.

§ 67.

A THORN, *(spina)*, is a strong projecting spine, that rises in the interior of the plant, and therefore does not come off with the bark; as in the sloe, Prunus *spinosa*. The kinds are,

1. Terminal, *(terminalis)*, when it is situated at the point of a branch.

2. Axillary, *(axillaris)*, when it is situated at the side or origin of the branch.

3. Simple, *(simplex)*, consisting of a single thorn.

4. Divided, *(divisa)*, divided at the point.

5. Branched, *(ramosa)*, separated into several branches *.

§ 68.

A PRICKLE, *(aculeus)*, is a persistent production that issues from the bark, and comes away with it, as in the rose, Rosa *centifolia*. Of it there are the following kinds:

1. Straight, *(recti)*, when the prickles are not bent.

2. Incurved, *(incurvi)*, when they are curved upwards.

3. Recurved, *(recurvi)*, when they are bent towards the ground.

4. Rolled up, *(circinnatus)*, when it is rolled up with its apex inwards.

5. Solitary, *(solitarii)*, when they stand at a distance.

6. Doubled, *(geminati)*, when two prickles stand together.

7. Palmated, *(palmati)*, when several hang together, as in the barberry, Berberis *vulgaris*.

* The origin of the thorn will be more particularly considered afterwards in the Physiology.

§ 69.

The AWN, *(arista)*, is a pointed beard, that sits on the flower of the grasses. It is,

1. Naked, *(nuda)*, not hairy, fig. 101, 103.

2. Feathered, *(plumosa)*, set with fine white hairs, as in the Stipa *pennata*.

3. Straight, *(recta)*, when quite straight, fig. 101, 103.

4. Geniculated, *(geniculata)*, that has a joint in the middle by which it is bent, as in the common oat, Avena *sativa*.

5. Bent, *(recurvata)*, when bent in the form of a bow.

6. Twisted, *(tortilis)*, when it is spirally twisted, or forms a serpentine line.

7. Terminal, *(terminalis)*, when situated on the point of the glume, § 65.

8. Dorsal, *(dorsalis)*, when inserted behind the apex, or on the back of the glume.

§ 70.

The HAIR, *(pilus)*, is a fine slender body, sometimes long, sometimes short; hairs are organs of transpiration, and serve for the covering of plants. The various divisions of hairs we have already mentioned in § 6. The kinds are,

1. Simple, *(simplices)*, that are not divided, but are of an equal filiform appearance.

2. Awl-shaped, *(subulati)*, short, strong hairs, that are thickest at the root, as those on the borage, Borago *officinalis*.

3. Needle-shaped, *(aciculares)*, very sharp pointed like the last, but at their base there is an enlargement.

4. Bulbous, *(bulbosi)*, that have a round bulb-like appendage at the base, as in Centaurea *Jacea.*

5. Hook-shaped, *(uncinati)*, that are bent like a hook, as in Scabiosa *succisa*, and various grasses.

6. Knobbed, *(nodosi)*, that have regular knobs with interstices between them.

7. Articulated, *(articulati)*, divided into regular and somewhat contracted members, so as to have the appearance of the antennae of some insects, as in Veronica *aphylla*, Lamium *purpureum*, Sonchus *oleraceus.*

8. Denticulated, *(denticulati)*, set on one side as it were with small teeth.

9. Pubescent, *(pubescentes)*, covered with very minute hairs, as in Hieracium *pilosella.*

10. Plumose, *(plumosi)*, that are thickly covered with long and very fine hairs, so that they resemble a feather, as in Hieracium *undulatum.*

11. Forked, *(furcati)*, that at the point are divided like a fork, as in the Apargia *hispida.*

12. Branched, *(ramosi)*, that divide irregularly into branches, as in the gooseberry, Ribes *grossularia.*

13. Stellated, *(stellati)*, when several hairs rise from one root, press close upon one another, and take the appearance of a star, as in Alyssum *montanum*, and various species of Solanum.

The hair is still further distinguished, according to its rigidity and point.

a. Hair, *(pilus)*, which is straight with some degree of stiffness.
b. Wool, *(lana)*, which is crooked and soft.
c. Fine hair, *(villus)*, very fine and soft.
d. Bristle, *(striga)*, that is very stiff.
e. Hook, *(hamus)*, that is stiff, and hooked at the point.
f. Double hook, *(glochis)*, that is stiff, divided at the point, and bent back towards both sides*.

§ 71.

The FLOWER, *(flos)*, is that part of the plant which appears before the fruit, and, in most cases, consists of coloured leafets called petals enclosing the essential organs of generation: but when these organs are not surrounded by such leafets they are themselves called the flower. The parts of the flower are the Calyx, the Corolla, the Nectarium, the Stamina, and the Pistillum.

§ 72.

The FLOWER is either simple, *(Flos simplex)*, or there are several seated close together on the same plane appearing to make but one, and this is called a compound flower, *(flos compositus*, s. *corolla composita vel communis)*. Of the simple flower there are several kinds, viz.

* The various form of the hair here described is proper to all the parts of a plant, and is only to be observed by a magnifying glass.

1. Naked, *(nudus)*, when there is neither calyx, (§ 74.), nor corolla, (§ 81).

2. Apetalous, *(apetalus)*, having no corolla, (§ 81.).

3. Aphyllous, *(corollaceus* s. *aphyllus)*, having no calyx, (§ 74.).

4. Hermaphrodite, *(hermaphroditus)*, having stamina, (§ 90.), and pistillum, (§ 94.)

5. Female, *(foemineus)*, having no stamina, (§ 90.).

6. Male, *(masculus)*, having no pistillum, (§ 94.).

7. Neuter, *(neuter)*, having neither stamina, (§ 90.), nor pistillum, (§ 94.).

Of compound flowers there are the following kinds:

1. Semifloscular, *(semiflosculosus)*, when they consist intirely of tongue-shaped florets, (§ 82. No. 10.), fig. 85. 270.

2. Discoid, *(discoideus* s. *flosculosus)*, when they consist intirely of tubular florets, (§ 82. No. 1.).

3. Radiate, *(radiatus)*, when they are composed of tubular florets (§ 82. No. 1.) in the centre, and tongue-shaped florets (§ 82. No. 10.) in the circumference, fig. 75. Of such flowers the centre, consisting of tubular florets, is called the disc, *(discus)*; and the circumference, containing tongue-shaped florets, is called the ray, *(radius)*.

4. Semiradiate, *(semiradiatus)*, when one side only of a compound flower has tongue-shaped florets.

§ 73.

In Mosses the flowers are only visible with a magnifying glass, and in them there are the following modes of inflorescence :

1. The flower formed like a bud, *(flos gemmiformis)*, is commonly seated between the leaves of the Moss : and has the appearance of a swollen bud.

2. The flower formed like a capitulum, *(flos capituliformis)*, is a spherical, foliaceous substance, which in Mosses appears raised on a peduncle, fig. 138.

3. The flower formed like a star, *(flos disciformis)*, is a body seated at the top of the stem of mosses ; it is flat, and furnished with broad leaves : it is conspicuous on the common polytrichum, Polytrichum *commune*, fig. 142 *.

§ 74.

The CALYX is a general name for all the little leaves or envelopes, that are commonly of a green colour, and surround the flower on the outside. The following are species of it : *Perianthium*, *Gluma*, *Anthodium*, *Squama*, and that of the Mosses *Perichaetium*, *Pappus*.

§ 75.

The PERIANTH, *(Perianthium)*, is that species of Calyx which immediately incloses a flower. It is,

* On Lichens there are sometimes small convex roundish bodies which some botanists consider as flowers : these are called *globuli* or *glomeruli*, as Lichen *farinaceus*.

1. Abiding, *(persistens)*, remaining after the flower falls of, as in the henbane, Hyoscyamus *niger*.

2. Deciduous, *(deciduum)*, that falls off at the same time with the flower, as in the lime tree, Tilia *europaea*.

3. Withering, *(marcescens)*, that withers after the flower, but still remains for some time, and at last drops off, as in the apricot, Prunus *Armeniaca*.

4. Caducous, *(caducum)*, that falls off before the flower, as in the poppy, Papaver *somniferum*.

5. Simple, *(simplex)*.

6. Double, *(duplex)*, when a double perianthium encloses the flower, as in the strawberry, Fragaria *vesca*, mallow, Malva *rotundifolia*, fig. 23, 57.

7. One-leaved, *(monophyllum)*, when the perianthium consists of one leaf, that is, it may be divided into equal or unequal laciniae, but all of them are connected at the base, fig. 49, 50, 53, 72, 73, 110.

8. Two, three, four, five-leaved, *(di, tri, tetra, penta*, &c. *phyllum*, many leaved, *(polyphyllum)*, when it consists of two or more foliola, fig. 148.

9. Dentated, *(dentatum)*, when it has at the margin short segments or indentations, but which are not deeper at most than the fourth part of the whole perianth. According to the number of these segments the perianth is, *bi, tri, quadri, quinque*, &c. or *multidentatum*, with two, three, four, five, or many segments.

10. Cleft, *(fissum)*, when the perianthium is divided into laciniae, but which reach only to the middle. It is often *bi, tri, quadri, multifidum*.

11. Parted, *(partitum)*, when the perianth is divided down to the base. These divisions are also named according to their number, as, *bi*, *tri*, *quadri*, &c. *multipartitum.*

12. Labiated or bilabiated, *(labiatum* s. *bilabiatum)*, when the perianth is deeply divided into two laciniae, both of which are dentated, as in garden sage, Salvia *officinalis*, fig. 73.

13. Intire, *(integrum)*, when a monophyllous perianth is short, round at the base, and intire on the margin, fig. 118.

14. Urceolated, *(urceolatum)*, when a monophyllous perianth is short, round at the base, and intire on the margin, fig. 118.

15. Shut, *(clausum)*, when a polyphyllous or divided perianth applies itself closely to the corolla.

16. Tubular, *(tubulosum)*, when a divided, cleft, or indented perianth, at its origin, is cylindrical and forms a tube.

17. Spreading, *(patens)*, when in a monophyllous or polyphyllous perianth, the foliola or laciniae stand quite open.

18. Reflected, *(reflexum)*, when either the segments or laciniae in monophyllous perianths, or the foliola in polyphyllous, are bent back.

19. Inflated, *(inflatum)*, when the perianth is hol low, and bellies out.

20. Abbreviated, *(abbreviatum)*, when the calyx is much shorter than the corolla.

21, Coloured, *(coloratum)*, when the perianth is of another colour than green *.

§ 76.

The GLUME, *(gluma)*, is the peculiar calyx of the Grasses. It contains in general several flowers. The leaves of which it consists are called valves, *(valvulae)*. The kinds are as follows:

1. Univalve, *(univalvis)*, that consists of only one valve, as in the ray-grass, Lolium *perenne*.

2. Bivalve, *(bivalvis)*, with two valves, as in most Grasses, fig. 96, 97, 102, 104.

3. Trivalve, *(trivalvis)*, when there are three valves, as in Panicum *miliaceum*.

4. Multivalve, *(multivalvis)*, that is composed of many valves.

5. Coloured, *(colorata)*, that is of another colour than green †.

§ 77.

The COMMON PERIANTHIUM, *(anthodium)*, is a calyx which contains a great number of flowers, in

* In a monophyllous Perianth, the divisions are either called *laciniae*, segments, or teeth, *(dentes)*, and these segments are distinguished by being obtuse *(obtusus)*, acute *(acutus)*, acuminated, *(acuminatus)*, thorny *(spinosus)*, &c. In the polyphyllous perianths, the particular pieces are called leafets *(foliola)*, and they are described according to their form. As to the figure of the Calyx and its parts, see the definition in § 6.

† The corolla of the Grasses, which is inclosed in the gluma, is also called gluma, because it hardly differs, in appear-

such a manner as that these flowers appear to form but one, as in dandelion, Leontodon *Taraxacum*, blue bottle, Centaurea *Cyanus*, sunflower, Helianthus *annuus*, &c. The kinds are,

1. One-leaved, *(monophyllum)*, that consists but of one leaf, united at the base, but divided at top.

2. Many-leaved, *(polyphyllus)*, that is compounded of several leaves.

3. Simple, *(simplex)*, when the flowers are surrounded by a single row of leaves, fig. 221.

4. Equal, *(aequale)*, when in a simple perianth the leaves are of equal length.

5. Scaly or imbricated, *(squamosum* s. *imbricatum)*, when the common perianth consists of closely imbricated foliola, fig. 59, 76.

6. Squarrose, *(squarrosum)*, when the foliola are bent back at the points.

7. Scariose, *(scariosum)*, when the foliola are hard and dry: this is found in the Centaurea *glastifolia.*

8. Fringed, *(ciliatum)*, when the margins of the foliola are beset with short bristles of equal length.

9. Muricated, *(muricatum)*, when the margins of the foliola are set with short stiff prickles.

10. Thorny, *(spinosum)*, when each leafet is provided with a thorn: these are either simple thorns, *(spinae simplices)*, or branched, *(ramosae)*, fig. 152.

ance from the calyx, and, properly speaking, is but an interior calyx. In accurate description, the word calyx or corolla is prefixed to gluma. The gluma of the corolla is somewhat finer than that of the calyx, and the inner valve is membranaceous, but the outer green. This green valve is either without an arista *(mutica)*, or awned *(aristata)*. The awn, *(arista)*, § 69, is only found on the corolla of Grasses, fig. 103.

11. Turbinated, *(turbinatum)* when the perianth has quite the figure of a top, fig. 59.

12. Spherical, *(globosum)*, when it has the form of a perfect sphere, fig. 152.

13. Hemispherical, *(hemisphaericum)*, when it is round below, and flat above, fig. 76.

14. Cylindrical, *(cylindricum)*, when the perianth is round and long, as thick above as below.

15. Flat, *(planum)*, when the foliola of the perianth are spread out quite flat.

16. Doubled or calyculated, *(auctum* s. *calyculatum)*, when at the base of the common perianth there is another row of foliola that appear to form another calyx, as in dandelion, Leontodon *Taraxacum*, fig. 143, 270*.

The common perianth, *(anthodium)*, is in general called by Linnaeus the common calyx, *(Calyx communis)*.

§ 78.

The foliola which cover the Catkin, § 40, serve in place of the calyx; and behind each stand the essential parts of the flower. These foliola are SCALES, *(squamae)*, fig. 37†.

* The leaves of the common perianth are called leafets, *(foliola* s. *squamae)*, and in accurate description are denominated according to their outline.

† The foliola of the common perianth, of the catkin, of the strobilus and other parts, are called likewise *squamae;* but the connection always shows distinctly of what we are speaking.

§ 79.

The PAPPUS, is a calyx consisting of hairs, or of a thin transparent membrane, observed only in particular flowers that are contained in a common perianth, *(anthodium)*. The pappus remains constantly till the ripening of the seed, and we shall consider it more fully when treating of the seed, (§ 117). Fig. 84, 86, 87.

§ 80.

The Mosses have a peculiar calyx, differently formed from that of other plants, called PERICHAETIUM. The flowers of Mosses are so small that they cannot be seen without the help of a high magnifier. In general they are of different sexes, that is, some are intirely male, others female flowers. The calyx of the female flower remains till the fruit is ripe and appears at the base of the seta. (§ 26). The male flower is only visible with a high magnifier, and disappears after the fructification is completed.

In the male flowers the calyx consists of a number of leaves, which differ from the other leaves in being of a finer structure, and of another form. The calyx of the female flower is best seen when the fruit is ripe, when it is observed at the base of the seta (§ 26), fig. 140. and consists of a number of imbricated leaves, which are distinguished from those of the Moss by their length or breadth. These leaves lie thick upon one another, and the whole is of a conical form.

§ 81.

The COROLLA is the envelope, or small leaves inclosed by the calyx, surrounding the interior parts of the flower, of a more delicate structure than the calyx, and of another colour than green. It consists either of one piece or of several; the first is called a monopetalous corolla, (*corolla monopetala*), the last polypetalous, (*corolla polypetala*). The pieces it consists of are called petals, (*petala*).

§ 82.

The MONOPETALOUS COROLLA is that which consists but of one piece, which, however, may be divided into segments, but which must always be intire at the base. The following are varieties of this corolla:

1. Tubular, (*tubulosa*), that consists of a single piece, hollow and of equal thickness. The small corolla or floret, which is found included in a common perianthium is also called tubular, although it sometimes departs from this form, fig. 60, 86, 275.

2. Club-shaped, (*clavata*), which forms a tube, growing gradually wider upwards, and narrower at the aperture, fig. 276.

3. Spherical, (*globosa*), which is narrow above and below, and wide in the middle, fig. 268.

4. Bell-shaped, (*campanulata*), that grows gradually wider to the mouth, so that it has nearly the appearance of a bell, fig. 62.

5. Cup-shaped, (*cyathiformis*), when a cylindrical tube grows gradually wider from below upwards,

but the margin is upright and not bent back or contracted, fig. 273, 82.

6. Urceolated, (*urceolata*), when a short cylindrical tube extends itself into a wide surface, the margin of which is erect, fig. 274.

7. Funnel-shaped, (*infundibuliformis*), when the tube of the corolla grows gradually wide above, that is, obversely conical, but the rim pretty flat and turned outwards, fig. 269.

8. Salver-shaped, (*hypocrateriformis*), when the tube of the corolla is perfectly cylindrical but very long, and the rim forms a broad expansion, fig. 267, as in Phlox.

9. Wheel-shaped, (*rotata*), when a cylindrical tube is very short, nearly shorter than the calyx, sometimes hardly perceptible, and its margin is quite flat. It is almost the same with the foregoing, only the tube is very short, as in Shepherd's club, Verbascum.

10. Tongue-shaped, (*ligulata*), when the tube is not long, suddenly ceases, and ends in an oblong expansion, as in the Aristolochia *Clematitis*, fig. 271, and in some flowers that are contained in a common perianthium, fig. 84.

11. Difform, (*difformis*), when the tube gradually becomes wider above, and is divided into unequal lobes, as in some corollas that are included in a common perianthium, *e. g.* the bluebottle, Centaurea *Cyanus*, fig. 61.

12. Ringent, (*ringens*), when the margin of a tubular corolla is divided into two parts, of which the upper part is arched, the under oblong, and has

some resemblance to the open mouth of an animal, as in sage, Salvia *officinalis*, fig. 72.

13. Masked, (*personata*), when both segments of the ringent flower are closely pressed together, as in snapdragon, Antirrhinum *majus*, fig. 49.

14. Bilabiate, (*bilabiata*), when the corolla has two segments or lips which lie over against each other, and which are themselves often laciniated or cleft, fig. 272.

15. One-lipped, (*unilabiata*), when in a ringent, personate, &c. corolla, the upper or under lip is wanting, as in Teucrium, fig. 50 and 51:

§ 83.

The kinds of the MANY-PETALLED COROLLA, (*corolla polypetala*), are,

1. Rose-like, (*rosacea*), when petals, which are pretty round, and at their base have no unguis, form a corolla, fig. 150, 195.

2. Mallow-like, (*malvacea*), when five petals, which at the base are considerably attenuated, so unite below that they appear to be monopetalous, fig. 56.

3. Cross-like, (*cruciata*), when four petals which are very much produced at their base, stand opposite to one another, as in Sinapis *alba*, Brassica *oleracea, viridis, &c.* fig. 145.

4. Pink-like, (*caryophyllacea*), when five petals at their base are much elongated, and stand in a monophyllous calyx, as in Dianthus *Caryophyllus, &c.* fig. 110.

5. Lily-like, (*liliacea*), when there are six petals but no calyx. In some there are only three, in others they form a tube at the bottom. This makes the idea somewhat indefinite; but it ought to be remarked, that this kind of corolla never has a calyx and that it is only proper to the lilies, (§ 125), fig. 66, 71, 146.

6. Two, three, four, five, &c. many petalled, (*di, tri, tetra, penta, &c. polypetala*), thus the corolla is denominated according to the number of the petals.

7. Papilionaceous, (*papilionacea*), when four petals differing in figure, stand together; to these petals the following names have been given: (for instances, examine the flowers of the common pea, Pisum *sativum*, or vetch, Vicia *sativa*, fig. 105, 30.)

a. The standard, (*vexillum*), is the uppermost petal, which is commonly the largest, and is somewhat concave, fig. 106.

b. The two wings, (*alae*), are the two petals which stand under the vexillum, and opposite to each other on each side, fig. 107.

c. The keel, (*carina*), is the undermost petal; it is hollow, and stands under the vexillum, and opposite to it; and contains the germen, with the stamina and pistillum, fig. 108.

8. Orchideous, (*orchidea*), is a corolla composed of five petals, of which the undermost is long and sometimes cleft; the other four are arched and bent towards one another, fig. 33.

9. Irregular, (*irregularis*), consisting of four or more petals, which are of different lengths and in-

clination, so that they do not come under the description of the other kinds, fig. 134.

§ 84.

A single division of the corolla as we observed (§ 81) is called a petal, *(petalum)*; when this is plane, the upper part is called *lamina*, the under part *unguis*.

The particular parts of the corolla have besides appropriate names. The following are those of the MONOPETALOUS COROLLA:

1. The tube, (*tubus*), of a monopetalous corolla is the under part, which is hollow, and in general of equal thickness. All flowers with this kind of corolla have a tube, except the bell-shaped, and sometimes the wheel-shaped.

2. The border, (*limbus*), is the opening of the corolla, especially when it is bent back, (§ 82, No. 1—11). The limbus is often dentated or deeply divided, and the divisions are called,

3. Segments or lobes, (*laciniae* s. *lobi*), and they are denominated according to their figure, number, and situation.

4. The helmet, (*galea*), is the upper arched lacinia of a ringent or masked corolla, which is further denominated according to its situation, figure, and segments or laciniae.

5. The gape, (*rictus*), is, in ringent flowers, the space between the two extremities of the helmet and the under lip.

6. The throat, (*faux*), in a monopetalous and ringent corolla, is the opening of the tube.

7. The palate, (*palatum*), in a personate corolla is the arch of the under lip, which is so elevated as to close the faux.

8. The beard, (*barba s. labellum*), is the under lip of a ringent and personate corolla.

9. The lips, (*labia*), in the bilabiate and unilabiate flowers, are the two divisions, the one called the upper lip, (*labium superius*), and the other the under lip, (*labium inferius*). The galea and barba are likewise by some botanists called lips.

§ 85.

The corolla of the Mosses differs in external appearance from that of all other plants. It has this remarkable peculiarity, that after flowering it remains till the ripening of the fruit, but then appears under a quite different form. The female flower alone is furnished with a corolla. It consists of a pretty hard membrane that closely embraces the pistillum. It is fastened both above and below, and thus after flowering it must be detached and be designated by various names. The under part perfectly resembles the vagina on the straw of the Grasses, and is inclosed by the *perichaetium*; it is called a little sheath, (*vaginula*). The upper part remains attached to the top of the fruit, and is called Calyptre, (*calyptra*).

The varieties of the calyptra shew themselves only when the fruit is ripe, and these we shall mention particularly afterwards, (§ 113).

§ 86.

Another important part of the flower is the NECTARY, (*nectarium*). Linnaeus comprehends in this all those bodies which have no resemblance to the other parts of the flower, in whatever variety of forms they may appear. These bodies, however, do not all secrete a sweet juice (*nectar*), and therefore do not all deserve the name of *Nectarium.* I shall in the mean time preserve this established name, and distinguish the various kinds by their functions. Nectaria may be divided into three kinds; 1. such as really secrete a sweet juice or honey; 2. such as serve for the preservation of it; and 3. those which protect the true secretory organs or stamina, and also serve for promoting the impregnation.

§ 87.

Nectaria, which really secrete and exude honey, are glands (*glandulae*), or nectariferous scales or pores, (*squamae nectariferae, pori nectariferi*). Of glands, there are the following varieties:

1. Sitting, (*sessilis*), which is not elevated on a foot-stalk, as in Sinapis, Brassica, &c. fig. 148.

2. Petiolated, (*petiolata*), which is furnished with a foot-stalk.

3. Spherical, (*globosa*).

4. Compressed, (*compressa*), which is flat on both sides.

5. Flat, (*plana*), that is scarcely convex, as in crown imperial, Fritillaria *imperialis.*

6. Oblong, (*oblonga*), that is besides of a long form.

7. Cup-shaped, (*cyathiformis*), that in form of a cup embraces the germen. When the seeds are ripe it changes into a hard, green body, as in the plants of the class Didynamia Gymnospermia, Asperifoliae, &c. fig. 74*.

The *squamae nectariferae* are small scales that exude honey, which is found in small holes, as in Ranunculus. The small scales often secrete no honey, and are then called simply scales (*squamae*).

The *Pori nectariferi* are small holes or pits exuding honey, and which are seen on different parts of the flower, as in Hyacinthus *orientalis*, &c.

§ 88.

Of the Nectaria, so called, which are destined for the reception and preservation of honey, there are the following kinds; *viz*. The hood, (*cucullus*); the tube, (*tubus*); the pit, (*fovea*); the fold, (*plica*); the spur, (*calcar*).

The HOOD, (*cucullus*), is a hollow body like a bag or hood, that is quite separated from all the other parts of the flower, and has commonly a short footstalk, as in monkshood, *Aconitum*, fig. 135, 196. In some flowers there are such hood-like bodies, which contain no honey, as in Asclepias *Vincetoxicum*, fig. 89.

* The glands are situated on every part of the flower, on the calyx, the corolla, the stamina and the pistillum. The glands alone secrete a honey juice.

The tube, (*tubus*), is a part of the flower that has perfectly the shape of a cylinder, and therefore among most botanists goes by the name. It is constantly attached to the flower, as in African cranesbill, Pelargonium, &c. fig. 306, 307.

The PIT, (*fovea*), is a cavity for the reception of honey, situated either in the calyx, the corolla, or in some other part of the flower, as in Hyptis, &c.

The FOLD, (*plica*), is an oblong groove, formed by the bending inwards of the corolla, which sometimes happens.

The SPUR, (*calcar*), is a horn-shaped production of the corolla in which honey is found. Sometimes in the pointed part of the spur there is a gland which contains honey, but sometimes it is secreted in another part, and thence flows into the spur, as in the March violet, Viola *odorata*; Indian cress, Tropaeolum *majus*, fig. 49, 112, 113.

§ 89.

All these parts of the flower may with propriety be called Nectaria; but some that are commonly called by the name are very different. Certainly those parts which serve for the protection of the nectarious juice, or of the pollen, or for the advancement of the fructification, deserve at least the name of reservoirs of honey. Such are the *Fornix*, the *Barba*, the *Filum*, the *Cylindrus*, and the *Corona*.

The ARCH, (*fornix*), is a small elongation of the corolla, which commonly covers the stamina, or is seated at the aperture of the corolla. Its form is very various, as in comfrey, Symphytum *officinale*, Borago, mouse-ear, Myosotis *scorpioides*, &c. fig. 81.

The BEARD, *(barba)*, consists of a number of short hairs or soft bristles which are situated at the opening of the calyx or corolla; or on the petals, or at the bottom of the flower, as in Thymus, Iris, Periploca, &c. fig. 71, 90, 92, 114.

The THREAD, *(filum)*, is a long thick body of a tender substance, and found very numerous in the bottom of the flower. The kinds are,

1. Straight, *(rectum)*, that has a quite straight direction, as in the passion-flower, Passiflora, fig. 27.

2. Horn-like, *(corniculatum)*, that is short and crooked like a horn, as in Periploca, fig. 83, 91.

The CYLINDER, *(cylindrus)*, is a thin, cylindrical body, surrounding the pistillum, (§ 94) and supporting the stamina at the margin, or on the upper part of the inner surface; as in Swietenia, Melia, fig. 309, 310.

The CROWN, *(corona)*, is a very variable body, which appears under many different forms, and in figure generally resembles the corolla. There are the following varieties:

1. One-leaved, *(monophylla)*, as in the Narcissus, fig. 146.

2. *Bi, tri, tetra*, &c. *polyphylla*, consisting of two three, four or many leaves, as in Silene, Stapelia, &c. fig. 66, 98, 100, 110, 111, 153, 154.

3. Hood-like, *(cucullata)*: this sort, an example of which may be found in Asclepias, covers the pistillum above, like a cap or hood, fig. 88.

4. Stamen-like, *(staminiformis)*, which has the appearance of a stamen, as in Stratiotes.

N. Under these divisions all the Nectaria of Linnaeus may be properly arranged and accurately determined. In some flowers, particularly the Asclepias, there appear small cartilaginous bodies, which are commonly called Tubercula, and seem to be imperfect or dried up glands.

The Nectaria of the Grasses appear very like the glume, but are distinguished by their extraordinary fineness. They are quite transparent, and very tender.

The plants which bear catkins, *(amenta)*, have likewise Nectaria, which are generally called squamae. They serve sometimes for the preservation of the honey, sometimes for other purposes.

In the flowers of Mosses there have hitherto been no traces of Nectaria discovered; we find, however, in these flowers transparent, articulated bodies, which have been called succulent filaments, *(fila succulenta)*, and which perhaps answer the purposes of Nectaria, fig. 127, 130, 131, 133.

The Stamens, (*stamina*), are one of the essential parts of the flower, and are long bodies which contain a quantity of dust or powder essential to the fructification.

The parts of the stamina are three, the filament, (*filamentum*), the anther, (*anthera*), and the powder, (*pollen*).

§ 91.

The FILAMENT, (*filamentum*), is a longish body that is destined for the support and elevation of the anther. In its figure it is very various.

1. Capillary, (*capillare*), that is all of equal thickness, and as fine as a hair.

2. Filiform, (*filiforme*), like the former, only thicker, fig. 68.

3. Awl-shaped, (*subulatum*), which is thicker below than above, fig. 67.

4. Dilated, (*dilatatum*), that is so compressed on the sides as to appear broad and leaf-like, fig. 69, 47.

5. Heart-shaped, (*cordatum*), the same with the foregoing, but with a margin above and pointed below, as in Mahernia, fig. 48.

6. Wedge-shaped, (*cuneiforme*), a dilated filament, that is pointed below but cleft above, as in Lotus *tetragonolobus.*

7. Loose, (*liberum*), that is not attached to any other filament.

8. Connate, (*connata*), when several grow together, forming a cylinder, as in the mallow, Malva, fig. 23, 27, 55.

9. Bifid, (*bifidum*), when a filament is divided into two parts.

10. Multifid or branched, (*multifidum* s. *ramosum*), when it is divided into many branches, as in Carolinea *princeps*, fig. 58.

11. Jointed, (*articulatum*), when the filament has a moveable joint, as in sage, Salvia *officinalis.*

12. Connivent, (*conniventia*), when several filaments bend towards one another at their points.

12. Incurved, (*incurvum*), that has a bend like a bow, fig. 45.

14. Declined, (*declinata*), when several filaments do not stand erect, but by degrees, without describing a large curve, bend towards the upper or under part of the flower, as in Pyrola.

15. Hairy, (*pilosum*), set with fine hairs.

16. Equal, (*æqualia*), that are all of equal length.

17. Unequal, (*inæqualia*), when some are long and some short, fig. 50, 51.*

§ 92.

The ANTHER, (*anthera*), is a hollow, cellular body, that contains a quantity of pollen. Its kinds are the following:

1. Oblong, (*oblonga*), which is long and pointed at both ends.

2. Linear, (*linearis*), that is long and flat, but all of equal breadth.

3. Spherical, (*globosa*).

4. Kidney-shaped, (*reniformis*), that is spherical on one side, but concave on the other, as in ground ivy, Glechoma *hederacea*, fox-glove, Digitalis *purpurea*, &c. fig. 68.

5. Doubled, (*didyma*), when two seem to be joined together, fig. 45.

* The filaments are attached to different parts of the flower, which in accurate description must be specified.

6. Arrow-shaped, (*sagittata*), that has a long point, and is cleft at the base into two parts, fig. 67.

7. Bifid, (*bifida*), that is linear, but cleft above and below, as in the Grasses, fig. 94.

8. Peltated, (*peltata*), that is circular, flat on both sides, and attached by the middle to the filament, as in the yew, Taxus *baccata*, fig. 64.

9. Dentated, (*dentata*), that on the margin has dents or indentations, as in the yew, Taxus *baccata*, fig. 64.

10. Hairy, (*pilosa*), that is covered with hair, as in the dead nettle, Lamium *album*, fig. 65.

11. Two horned, (*bicornis*), which has at its apex two subulate prolongations, as in Pyrola, Arbutus, Erica, &c. fig. 63.

12. Awned, (*aristata*), that at the base has two bristle-shaped appendages, as in Erica.

13. Crested, (*cristata*), when two cartilaginous points are set on the sides or on the base, as in some heaths, Ericae.

14. Awnless, (*mutica*), when it has neither awn nor crest. It is the opposite of No. 12, 13.

15. Angulated, (*angulata*), that has several deep furrows, that form four or more angles.

16. Bilocular, (*bilocularis*), when the anther is divided by a partition into two parts or cells.

17. Unilocular, (*unilocularis*), when there is but one cell or cavity in the anther.

18. Bursting at the side, (*latere dehiscens*).

19. Bursting at the point, (*apice dehiscens*).

20. Free, *(libera)*, that is not attached to another anther.

21. Connate, *(connata)*, when several grow together, forming a tube, fig. 84, 86, 87.

22. Erect, *(erecta)*, standing with its base straight on the point of the filament, fig. 67.

23. Incumbent, *(incumbens)*, that is perpendicularly, or even obliquely attached to the filament, fig. 55, 126.

24. Lateral, *(lateralis)*, that is attached by its side to the point of the filament, fig. 68.

25. Moveable, *(versatilis)*, when Nos. 23 and 24 are so slightly attached to the filament that the least motion agitates the anther.

26. Adnate, *(adnata)*, when the anther is closely attached to both sides of the point of the filament, fig. 69.

27. Sitting, *(sessilis)*, that has no filament.

The internal structure of the anther is described particularly in the Physiology.*

* The antherae in almost all plants consists of a cellular membrane which contains the pollen; but in the species of Orchis, (§ 146. No. 7.) and in certain plants allied to Asclepias they have no membrane; the pollen in these plants is glutinous, and hangs together in the form of an Anther.

The flowers of the Mosses contain only single particles of pollen which are attached to the flower by small articulated threads hardly observable, and sometimes even without them. These particles of pollen open at the apex, fig. 127.

In the Filices and Fungi there are also no antherae or filaments, but small particles of pollen.

The Equisetum has broad spatula-shaped filaments which are strewed with single particles of pollen. fig. 10.

§ 93.

The POLLEN is a powder, that appears in the form of the finest dust. In the microscope its figure is various, being hollow and filled with a fertilizing moisture, of which more will be said in the Physiology.

§ 94.

The PISTIL, *(pistillum)*, is the second essential part of the flower. It stands constantly in the middle, and consists of three parts, *viz.* the *Germen*, *Stylus* and *Stigma.**

§ 95.

The GERMEN is the undermost part of the pistillum, and is the rudiment of the future fruit. The number of germina is very various; they are reckoned from six to eight, after which they are said to be several or many germina. The figure is also very different. The principal kinds are,

1. Sitting, *(sessile)*, that has no foot-stalk, fig. 46.

2. Pedicelled, *(pedicellatum)*, furnished with a foot-stalk, fig. 27, 144.

3. Superior, *(superum)*, when the germen is encircled by the calyx; or, when this is wanting, by the other parts of the flower, fig. 115, 122.

* The pistillum and the stamina are the organs of generation in plants, as will be shewn in the Physiology.

4. Inferior, *(inferum)*, when the Germen is situated under the calyx; or, when this is wanting, under the corolla, fig. 118, 153.*

§ 96.

The STYLE, *(stylus)*, is seated upon the germen, and resembles a small column or stalk. The kinds of it are the following:

1. Hair-like, *(capillaris)*, that is very slender, and of equal thickness.

2. Bristle-like, *(setaceus)*, as slender as the former, but somewhat thicker at the base.

3. Thread-like, *(filiformis)*, which is long and round.

4. Awl-shaped, *(subulatus)*, thick below, above sharp-pointed.

5. Gross, *(crassus)*, that is very thick and short.

6. Club-shaped, *(clavatus)* thicker above than below.

7. Two, three, four, &c. multifid, *(bi, tri, quadri, &c. multifidus)*, cleft in a determined manner.

8. Dichotomous, *(dichotomus)*, divided into two parts, which are again divided at the points.

* When we speak of the situation of the germen, we must be understood to mean its situation with respect to the calyx, for there may be instances of the germen being encircled by the calyx, and yet being situated below the corolla. It is only in absence of the calyx that the situation is determined by the other parts. *Germen inferum* is also expressed by *Flos epicarpius*, or *Flos superus*; and *Germen inferum* by *Flos hypocarpius*, or *Flos inferus*.

9. Terminal, *(terminalis)*, which stands on the top of the germen.

10. Lateral, *(lateralis)*, attached to the side of the germen.

11. Erect, *(rectus)*, which stands straight up.

12. Declined, *(declinatus)*, that inclines towards the side.

13. Abiding, *(persistens)*, that does not fall off.

14. Withering, *(marcescens)*, that withers and afterwards falls off.

15. Deciduous, *(deciduus)*, that falls off immediately after impregnation.

The number of the styles must likewise be accurately counted, for there are often more than one style to one germen, and this must be particularly observed. The length of the style, whether longer or shorter than the stamina, is also to be mentioned.

§ 97.

The STIGMA means the top of the style. The kinds of it are as follows:

1. Pointed, *(acutum)*, when it is a sharp point.

2. Blunt, *(obtusum)*, when it forms a blunt point.

3. Oblong, *(oblongum)*, when it is thick and elongated.

4. Club-shaped, *(clavatum)*, resembling a small club.

5. Spherical, *(globosum)*, forming a perfectly round globe.

6. Capitate, *(capitatum)*, a hemisphere, the under side flat.

7. Emarginated, *(emarginatum)*, when the last mentioned kind has a notch in it.

8. Peltated, *(peltatum)*, that is formed like a shield.

9. Uncinated, *(uncinatum)*, hooked at the point.

10. Angular, *(angulosum)*, when it is furnished with close and deep furrows, which occasion projecting angles.

11. Three-lobed, *(trilobum)*, which consists of three round bodies, somewhat pressed flat, fig. 153.

12. Dentated, *(dentatum)*, when it is set with fine teeth.

13. Cruciform, *(cruciforme)*, when it is divided into four parts, of which two are always opposite to each other.

14. Pencil-like, *(penicilliforme)*, consisting of a number of short, thick, close, fleshy fibres, in form of a pencil.

15. Hollow, *(concavum)*, when it is of a globular or longish form, but quite hollow, as in the violet.

16. Petal-like, *(petaloideum)*, when it has the appearance of a petal, as in Iris, fig. 70.

17. Two, three, &c. multifid, *(bi, tri, &c. multifidum)*, fig. 84.

18. Bent back, *(revolutum)*, when the points of a bifid or multifid stigma are rolled back outwards, fig. 84.

19. Bent in, *(convolutum)*, when the points of a divided stigma are rolled inwards.

20. Spiral, *(spirale)*, when a multifid stigma is rolled up like the spring of a watch.

21. Plumose, *(plumosum)*, when the stigma is set with fine hairs on both sides so as to have the ap-

pearance of a feather, as in the Grasses, fig. 94. 95.

22. Hairy, *(pubescens)*, that is set with short white hairs.

23. Lateral, *(laterale)*, which is situated on the side of the stylus or of the germen.

24. Sitting, *(sessile)*, which when there is no style rests on the germen.

The stigma, properly speaking, consists of a number of inhaling tubercles, which are not always visible without a magnifier. In the Mirabilis *Jalapa* they are to be seen most distinctly.

§ 98.

The pistillum of Mosses is furnished with a germen, stylus, and stigma, like other plants. But in this tribe there are several pistilla, some only of which form perfect fruit, the others are barren: these last are called *Adductores.* The Equsietum has no style, neither have the other Filices and Fungi. In the Filices, the pistillum has the appearance of a small grain, so likewise that of the Fungi, only in this it is drawn together like a small net. In all these plants the parts can be observed only by means of a high magnifier.

§ 99.

When plants have done flowering there proceeds from the germen (§ 95) the fruit, *(fructus.)* This is either naked seeds, *(semen)*, or a skin, hard shell, or other substance containing the seeds, called pericarp, *(pericarpium)*, (§ 100). Thus all plants may be brought under two great divisions, namely, such as have naked seeds, *(vegetabilia gymno-*

spermia), that is to say, such where the germen changes into one or more naked seeds; and such as have their seeds covered, *(vegetabilia angiospermia)*, or those whose germen changes into a pericarpium. Of the first kind, namely the naked seeded plants, there have yet been discovered only four varieties, *viz.*

1. One-seeded, *(vegetabilia monosperma)*, where the single germen is one naked seed.

2. Two-seeded, *(disperma)*, when out of two or one germen in a flower there proceed two naked seeds.

3. Four-seeded, *(tetrasperma)*, when four germina or one four-partitioned germen in a flower change to four naked seeds.

4. Many-seeded, *(polysperma)*, when out of several germina in one flower there proceed several naked seeds.

The parts of the pericarpium and the seed are subject to much variation, which we shall exemplify in the following paragraphs.

§ 100.

The PERICARPIUM is a cavity of various figure, containing seeds. The kinds of it are, *Utriculus*, *Samara*, *Folliculus*, *Capsula*, *Nux*, *Drupa*, *Bacca*, *Pomum*, *Pepo*, *Siliqua*, *Legumen*, *Lomentum*, and *Theca*.

§ 101.

The BLADDER, *(utriculus)*, consists of a thin skin, which incloses a single seed. The kinds of it are these,

1. Loose, *(laxus)*, that holds the seed inclosed quite loose, as in Adonis, Thalictrum, fig. 165, 166.

2. Strait *(strictus)*, that quite closely surrounds the seed, as in ladies bedstraw, Galium.

3. Cut round, *(circumscissus)*, that bursts in the middle, and detaches itself, as in Amaranthus.

N. The Utriculus is distinguished from the exterior coat of the seed by this, that between the seed and the external coat there is a space, and that the seed is connected with it by the umbilical chord. The utriculus differs from the nut in being less hard and more yielding.

§ 102.

The WINGED-FRUIT, *(samara)*, is a pericarpium, which contains one or at most two seeds, and is surrounded by a thin, transparent membrane, either in its whole circumference, or at the point, or even on the side. Examples of this are seen in the fruit of the elm, *ulmus*, fig. 162, 163; mapple, *acer;* ash, *fraxinus;* birch, *betula;* and many others. The kinds of it are determined by the number of the seeds, whether there be one or two in the fruit, or according to the place to which the thin membrane is attached, which is called the wing, *(ala)*.

§ 103.

The FOLLICLE, *(folliculus)*, is an oblong pericarpium, which bursts longitudinally on one side, and is filled with seeds. The follicle is seldom single, there are generally two together. Its varieties are determined according to the attachment of the seed; when, for example, there is a partition in the middle to which the seed is fixed; or when it is attached to both sutures at which this fruit bursts; as in Asclepias *syriaca*, Vinca, Oleander, &c. fig. 170.

§ 104.

The CAPSULE, *(capsula)*, is a pericarpium, consisting of a thin coat which contains many seeds, often divided into cells, and assuming various forms. The parts of the capsule are the following:

a. The partition, *(dissepimentum)*, is a firm membrane that intersects and divides the inner cavity of the capsule.

b. The cells, *(loculamenta)*, are the spaces between the partitions.

c. The *columella* is a filiform body that passes through the middle of the Capsule, and to which the partitions are attached, fig. 169.

d. The valves, *(valvulae)*, form the outward coat of the Capsule, which bursts longitudinally in several parts.

e. The suture, *(sutura)*, is a deep furrow which appears on the outside of the coat.

The different sorts of capsules are distinguished according as they are round, long, &c. and further, according as they are,

1. Unilocular, *(unilocularis)*, when there are no divisions.

2. Two, three, four, &c. or many celled, *bi, tri, quadri*, or *multilocularis*, according to the number of the cells, fig. 155.

3. Two, three, &c. or many-valved, *bi, tri*, &c, *multivalvis*, according to the number of the valves that appear on the bursting of the capsule, fig. 156, 169.

4. Two, three, &c. many-seeded, *(bi, tri*, &c. *polysperma)*, according to the number of the seeds.

5. Tricoccous, *(tricocca)*, when a trilocular capsule appears as if three were grown together, as in the tea-shrub, Thea *viridis*, Euphorbia, Ricinus, &c.

6. Berried, *(baccata)*, when the coat is fleshy and soft.

7. Corticated, *(corticata)* when the external coat is hard, and the internal soft; or when the external is spongy, and the inner membranaceous, as in Magnolia, Illicium *anisatum*.

Woody, *(lignosa)*, when the coat is very hard, but still bursts in valves.

The Capsule has different names according to the various ways in which it opens, *e. g.* bursting at the top, *(apice dehiscens)*; bursting at the base, *(basi dehiscens)*, bursting in the middle, *(circumscissa)*, opening with a lid, *operculata*, &c.

The fruit of the Hepatic Mosses, *(Musci hepatici)*, is likewise called a Capsule. They have over the Capsule a thin, light, deciduous membrane called calyptre, *(calyptra)*. The Capsule bursts in four or two valves, *(quadri- vel bivalvis)*, fig. 227, or it opens with a lid, or with a number of teeth at the apex; as in Marchantia.

The Filices present but three varieties in their capsule.

1. Bivalve, *(bivalvis)*, when it opens in two valves and is quite smooth; fig. 294.

2. Annulated, *(annulata)*, when it is encircled by an articulated ring *(fimbria* s. *annulus)*, by which means the opening is irregular, fig. 295, 296.

3. Separating by a cleft, *(rima dehiscens)*, when it opens from above in a small chink, fig. 303.

§ 105.

The NUT, *(nux)*, is a seed covered with a hard shell which does not burst; as the hazle-nut, Corylus *Avellana*, the oak, Quercus *robur*, the hemp, Cannabis *sativa*, fig. 205. The shell is called *Putamen* and described according as it is hard *(durum)*, or brittle *(fragile)*. The seed contained in the nut is called the kernel *(nucleus)*. We remark likewise whether the nut is two or three-seeded, *(bi*, vel *trisperma)*, or whether it is divided into cells, namely, two, three, or many-celled, *(bi, tri*, vel *multilocularis)*.

§ 106.

The DRUPE, *(drupa)*, is a nut which is covered with a thick, fleshy, succulent or cartilaginous coat. The following are its varieties:

1. Berried, *(baccata)*, when it is surrounded by a very succulent coat; as in the cherry, Prunus *Cerasus;* the plumb, Prunus *domestica;* Peach, Amygdalus *Persica;* Apricot, Prunus *Armeniaca, &c.*

2. Fibrous, *(fibrosa)*, when instead of a fleshy it

has a fibrous coat, as in the cocoa-nut, Cocos *nucifera.*

3. Dry, *(exsucca)*, when instead of a fleshy coat, it is covered with a spongy, membranaceous or coriaceous substance, as in the walnut, Juglans *regia;* almond, Amygdalus *communis;* Tetragonia *expansa,* Sparganium.

4. Winged, *(alata)*, when the Drupa has a membranaceous rim, which is called a wing, as in Halesia.

5. Bursting, *(dehiscens)*, when the external rind bursts. Properly speaking this is not peculiar to the Drupa, but it is the case with many species, as in the walnut, Juglans *regia;* nutmeg, Myristica *moschata*, fig. 204, 209, 211.

6. One, two, three, four nutted, &c. *(mono, bi, tri, tetrapyrena)*, which contains one, two, three or four nuts. But if the hard shell of the nut grows to the kernel, it is called a pyrenous berry.

In accurate description we must attend to the figure of the nut, as well as to its cells. The nut of the Drupa has sometimes two, three, or more cells, fig. 171, 172, 173.

§ 107.

The BERRY, *(bacca)*, is a succulent fruit which contains several seeds, and never bursts. It incloses the seeds without any determinate order; or it is divided by a thin membrane into cells. There are the following kinds:

1. Succulent, *(succosa)*, which consists of a very soft, succulent substance, as in the gooseberry, Ribes *Grossularia*, &c.

2. Corticated, *(corticosa)*, which is covered with a hard rind, so that it cannot be pressed. It might be taken for a capsule, but it never bursts, and is filled with a juicy substance in which the seeds lie, as in Garcinia *Mangostana*.

3. Dry, *(exsucca)*, that instead of a fleshy substance, is covered with a coriaceous or coloured skin, as in the ivy, Hedera *helix*, Tilia.

4. One, two, three, many-seeded, *(mono, bi, tri, polysperma)*, according to the number of seeds which the berry contains.

5. One, two, three, many-celled, *(uni, bi, tri, multilocularis)*, according to the number of cells into which the berry is divided.

6. Two, three, &c. pyrenous, *(di, tripyrena, &c.)* when the particular seeds have a hard shell like a nut, but with this difference, that the hard rind is inseparably attached to the skin of the seed, as we have already said, § 106, No. 6. In the species of apple this is sometimes the case.*

*Of the Berry it is further to be remarked, that if in one flower there are many styles, and each of the germina bears a berry, all the small berries *(acini)* grow into one, and are called a compound berry *(bacca composita)*, as in the rasp, Rubus *idaeus* &c.

This is likewise the case in the Drupa, *e. g.* the breadfruit, Artocarpus.

In descriptions the figure of the berry must be carefully attended to.

§ 108.

The APPLE, *(pomum)*, is a fleshy fruit, that internally contains a capsule for the seed. It differs from the celled berry, in having a perfect capsule in the heart. It is considered according to its substance and figure, whether it is fleshy or coriaceous, round, long, &c. Examples of this sort of pericarpium we have in the common apple, Pyrus *malus*, pear, Pyrus *communis*, quince, Pyrus *cydonia*, &c.

§ 109.

The PUMPKIN, *(pepo)*, is commonly a succulent fruit, which has its seeds attached to the inner surface of the rind, as in the gourd, Cucurbita *Pepo;* cucumber, Cucumis *sativus;* melon, Cucumis *Melo*; passion flower, Passiflora; water-soldier, Stratiotes *aloides*, &c. The sorts of Pepo are,

1. One, two, three, &c. many locular, *(uni, bi, tri, &c. multilocularis)*, according to the number of the cells, fig. 210, 212.

2. Half-locular, *(semilocularis)*, when the partition does not reach to the centre.

3. Fleshy, *(carnosa)*, that is full of a firm, fleshy substance.

4. Juicy, *(succosa)*, that is filled with a very soft substance.

5. Dry, *(exsucca)*, that contains neither fleshy nor soft substance.

6. Cortical, *(corticosa)*, which has a very firm, hard rind.

The external figure of the Pepo is not very various, and is, in general, either round, club-shaped, oblong, &c.

§ 110.

The SILIQUE, *(siliqua)*, is a dry, elongated pericarp, which consists of two halves or valves, and externally, where these are connected, forms an upper and under suture. Internally the seeds are attached to the margin of the partition on both sides of the suture, the upper as well as the under, *e. g.* in the mustard, Sinapis *alba*, cabbage, Brassica *oleracea*, *&c.* fig. 190, 191. When the Siliqua is as broad as it is long, it is called silicle *(silicula)*, fig 187, 188, as in the garden cress, Lepidium *sativum*; shepherd's purse, Thlaspi *Bursa pastoris*. The Siliqua is distinguished according to the situation of the partition, *(dissepimentum)*. When both valves of this pericarpium are flat, and the partition, which reaches from one suture to the other, is of equal breadth, we say the valves run parallel with the partition, *(valvulis dissepimento parallelis)*. But if both valves are swelled and hollow, so that the two sutures stand in the centre of the pericarp, and the partition is much narrower than the greatest breadth of the fruit, we say, the valves run contrary to the partition, *(valvulis dissepimento contrariis)*. Many varieties take place in the figure of the Siliqua *.

* Of the Siliculae, there are some which have a double shell, the exterior softer and spongy, the interior harder, which contains the seed, inclosed in cells. These are called drupaceous Silicles, *(siliculae drupaceae)*. But the kinds of silicle which never burst, are called *baccatae*. Of the first kind, Bunias, and of the second, Crambe, afford examples

§ 111.

The LEGUME, *(legumen)*, is a dry, elongated pericarp, that consists of two halves or valves, externally forming two sutures. The seeds are attached to both margins of the under suture only. The kinds of the legumen are,

1. Membranaceous, *(membranaceum)*, when both valves consist of a transparent membrane.

2. Coriaceous, *(coriaceum)*, when the two valves are of a thicker and tougher substance.

3. Fleshy, *(carnosum)*, when the two valves consist of a soft fleshy substance.

4. Woody, *(lignosum)*, when both valves are as hard as a nut-shell, and do not burst.

5. Mealy, *(farinosum)*, when the seed is surrounded with a mealy substance, as in Hymenaea *Curbaril.*

6. Torolose, *(torolosum)*, when both valves are round and thick, fig. 174, 175.

7. Ventricose, *(ventricosum)*, when the valves internally are distended with air.

8. Compressed, *(compressum)*, when the valves are both flat.

9. Channelled, *(canaliculatum)*, when the upper suture is deeply furrowed, as in Lathyrus *sativus.*

10. One, two, or many-seeded, *(mono, di,* vel *polyspermum)*, according to the number of the seeds.

11. Spiral, *(cochleatum)*, when it is twisted like the shell of a snail, as in Medicago *.

§ 112.

The LOMENT, *(lomentum)*, is an elongated pericarpium, consisting of two valves; externally it forms sutures, but, it never bursts like the legume. Internally it is divided into cells by small transverse partitions, which contain only one seed attached to the under suture. It never bursts longitudinally, like the two former pericarps; but when it opens, the partitions detach themselves in small pieces. The kinds of this pericarp are the following:

1. Cortical, *(corticosum)*, when the outer shell is very hard and woody, but the internal cavities are filled with a soft substance, as in Cassia *Fistula*, fig. 192, 194.

2. Articulated, *(articulatum)*, when the transverse partitions appear distinctly on the outside, and are easily divided into joints, as in Hedysarum.

3. Intercepted with isthmuses, *(isthmis interceptum)*, when the transverse partitions are easily seen, and also easily separate, but the cells are much smaller than the articulations, as in Hippocrepis †.

* There are still other kinds, which are named according to their figure, and according as the surface is set with hairs, bristles, wings, points, or prickles.

† It is not the transverse partition that distinguishes the loment from the legume: the principal character of the loment consists in its not separating longitudinally into two halves, but either not opening at all or being detached in small pieces.

§ 113.

The CASE, *(theca)*, is the fruit of the frondose Musci. It is a dry fruit that opens in the middle with a lid, and is furnished with particular parts.

A. The Calyptre, *(calyptra)*, is a tender skin that like a cup loosely covers the top of the theca, (§ 85). It is,

1. Intire, *(integra)*, that wholly covers the top of the theca, as in Grimmia *extinctoria*.

2. Half, *(dimidiata)*, that only half covers the top of the theca, as in most Musci, fig. 138.

3. Hairy, *(villosa)*, that is composed of hairs, as in Polytrichum, fig. 136.

4. Dentated, *(dentata)*, when the rim is set with teeth, as in Grimmia *dentata*.

B. The Lid, *(operculum)*, is a round body that closes the opening of the theca, and when the seed is ripe falls off. It is,

1. Convex, *(convexum)*, that has a raised or arched surface.

2. Conical, *(conicum)*, that is wide below, but runs above into a round point.

3. Acute, *(acutum)*, that is wide below, but above grows gradually into an acute point, fig. 138.

4. Acuminated, *(acuminatum)*, when the upper part is drawn out into a very long point, fig. 137.

5. Flat, *(planum)*, when the operculum is quite flat.

6. Mucronate, *(mucronatum)*, when the operculum is quite flat, but on the upper side, in the centre, has a bristle-like point.

C. The Fringe, *(fimbria* s. *annulus)*, is a narrow sinuated membrane, that is set with small membranaceous teeth, and lies within the operculum. This body possesses great elasticity, and thus serves to throw off the operculum from the theca, fig. 261.

D. The Mouth *(peristoma* s. *peristomium)*, is the membranaceous rim which surrounds the mouth of the theca. The peristoma is of two kinds:

1. Naked, *(nudum)*, that is intire without either teeth or eminences, fig. 178.

2. Dentated, *(figuratum)*, set with membranaceous teeth.

a. With one row, *(ordine simplici dentatum)*, when there is a single row of teeth round the opening. These are distinguished according to their number and situation, &c. as,

α. Four, sixteen, or thirty-two dentated, *(quadri, sedecim,* vel 32 *dentatum)*. No other differences in the teeth have been yet observed, fig. 176, 177, 179, 180.

β. With divided teeth, *(dentes bifidi)*, when the points of the teeth are divided.

γ. Twisted, *(contorti)*, when the teeth are drawn together, and twisted into the form of a cylinder, fig. 184.

b. With a double row, (*ordine duplici dentatum*), when behind one row of teeth there is a second, fig. 181.

α. Not cohering, *(non cohaerentes)*, when the teeth of the inner row do not cohere, but stand free.

β. Cohering at the points, *(apice cohaerentes)*. When the teeth of the inner row cohere at their points.

γ. Ciliato-dentate, *(ciliato-dentatum)*, when the inner row has alternately teeth and bristles.

δ. Membranaceo-dentate, *(membranaceo-dentatum)*, when the teeth of the inner row cohere below by means of a membrane.

E. The Epiphragm, *(epiphragma)*, is a thin membrane, which stretches over the mouth of the theca; it is found only in the genus Polytrichum, fig. 176.

F. The Seed-column, *(sporangidium* s. *columnula)*, is a slender, thread-like body, that passes through the middle of the theca, and to which the seed is attached. It is analogous to that body which in a capsule is called by the same name.

G. The *Apophysis* is a fleshy, round, or oblong body, that appears at the base of the theca. Sometimes it is very small, and almost imperceptible; sometimes, however, larger than the theca itself, fig. 176, 179.

In one genus of Musci (the Phascum), the operculum never separates from the theca: but as soon as the seed is ripe, the whole theca falls off. As no mouth can be seen in this Moss, it is said to be without one *(peristomium nullum)*.

§ 114.

In the Fungi the capsules are hidden in the substance of the gills, pores, prickles or papillae, or where these are wanting, in the fleshy substance. The capsules open at the top and disperse the seeds in the form of very slender fibres. In the genus Peziza, there are eight seeds in a capsule, fig. 286, 287. In some species of the same genus the seeds are included by twos in one membrane, and there are eight of these double seeds in one capsule, fig. 283, 284. Different genera of Fungi, and among others the Lycoperdon, have numerous seeds, which compose their whole inner substance, fig. 7.

§ 115.

According to the explanation given § 99, the fruit is that part which is formed from the germen, whether it change into naked seeds or into a pericarpium. The botanist can never form a proper judgement of any fruit till he is acquainted with the mode of its production. The calyx, the corolla, the nectarium, the receptacle, may after flowering envelope the germen, may grow with it, and thus form a particular sort of fruit that may have the appearance of a pericarpium without being one. Such a production is called a false fruit, *(fructus spurius)*. Some of these, on account of their resemblance, have got the name of that sort of pericarp which, without accurate investigation, they most nearly resemble. Others have got peculiar names; for instance,

1. The Strobile, *(strobilus)*, is a catkin, (§ 40.), the scales of which have become woody, and, according to the nature of the plants, contain one or two loose seeds, or even nuts, under each scale. The whole has the appearance of a particular sort of fruit. The kinds of the strobilus are,

α. Cylindrical, *(cylindricus)*, fig. 193.
β. Conical, *(conicus)*.
γ. Ovate, *(ovatus)*.
δ. Spherical, *(globosus)*, &c.

2. The false capsule, *(capsula spuria)*. The Beech, Fagus *sylvatica* bears such. The proper fruit of this tree are two three-cornered nuts that stand close together, and are encompassed by a coricaceous prickly calyx, which has the appearance of an unilocular, four-valved capsule. The dock, Rumex, bears but a single seed, which the abiding calyx surrounds like a capsule. The Carex bears one seed, which is enclosed by the nectarium, and thus acquires a capsule-like form.

3. The false nut, *(nux spuria)*. The Trapa *natans*, has a single seed which is attached to the calyx, the foliola of which change into a hard nut-shell with four spines. The Coix *Lachryma Jobi*, has a single seed, enclosed however by the calyx and corolla, and becomes hard and shining like a stone. The Mirabilis *Jalapa*, retains the under part of the tube of the corolla, which grows with the seed, and forms a nut.

4. The false drupa, *(drupa spuria)*. The yew, Taxus *baccata*, bears a nut that is half sunk in the fleshy receptacle, and thus appears like a drupa.

This is the case likewise with the Anacardium and Semicarpus, (§ 117.

5. The false berry, *(bacca spuria)*. The juniper, Juniperus *communis*, has a catkin, (§ 40.), and must regularly bear a strobilus; but the scales grow together, become fleshy, and assume the appearance of a berry. The strawberry, Fragaria *vesca*, bears detached seeds upon a fleshy receptacle, and looks like a berry, (§ 119.). The Basella encloses its seeds in the calyx and corolla, which become fleshy, and thus has the appearance of a perfect berry.

More examples of this kind may be learned by attentive observation.

With regard to the Strobilus it remains to be noticed, that we often falsely so call the scaly imbricated seeds of the tulip-tree, Liriodendron *tulipifera*, and the imbricated capsules of the Magnolia, fig. 159. But the Strobilus proceeds only from a catkin.

§ 116.

The SEED, *(semen)*, is that part of the plant which is destined to its propagation. It consists of two halves, which change at germination into leaves, and are called seed-leaves or cotyledons, *(cotyledones)*. Between these, on one side, lies the corcle, *(corculum)*, which consists of two bodies, one sharp-pointed, which descends into the earth, and becomes a root, rostel, *(rostellum)*; the other ascending, and destined afterwards to form the stem and leaves, called plumule, *(plumula)*. The seed besides is covered with a double integument, the outer one being thick and of a firm consistence, the inner transparent and tender. The external one is called the external tunic, *(tunica externa)*, the inner, the internal membrane, *(membrana interna)*. The place in the seed which is occupied by the corculum may be seen externally, as it is marked by a deep impression called the eye, or external scar, *(hilum)*. The seed, till it has attained its full ripeness, is fastened by a small thread called the umbilical cord, *(funiculus umbilicalis)*.

Plants have been divided according to the various ways in which the seed germinates; viz. such as have no seed-leaves are called acotyledonous, *(acotyledones)*; such as have one, two, or more seed-leaves, are called monocotyledonous, &c. *(mono, di, polycotyledones)*. But an accurate observation of nature shows the above division to be inept. In what different ways seeds germinate will be shown in the Physiology.

The forms of the seed are very various, but they are easily distinguished. By means of the umbilical cord, seeds are attached, in the pericarpium, either to the rim, to the receptacle, to the inner surface, to the valves, &c.; but when they are found so close in a berry that their attachment cannot easily be seen, they are said to be nidulant seeds, *(semina nidulantia)*. The substance of seeds is firm, and we have but few examples of soft seeds. Linnaeus sometimes speaks of two-celled seeds, *(semina bilocularia)*; but such can no more occur in nature than eggs with two cells; what Linnaeus thus calls, are generally two-celled nuts *.

§ 117.

To the seed and to the pericarp belong yet other organs, which contribute to the accurate knowledge of plants. These parts are the *Arillus*, the *Pappus*, the *Desma*, the *Cauda*, the *Rostrum*, the *Ala*, the *Crista*, the *Costa*, the *Verruca*, the *Pruina*, the *Elater*, the *Capillitium*, and the *Trichidium*.

1. The ARILLUS is a soft membrane extended over the seed; it is called,

a. Succulent, *(succulentus, baccatus,* s. *carnosus)*, when it is thick and fleshy, as in the spindle-tree, Euonymus *europaeus*.

b. Cartilaginous, *(cartilagineus)*, when it is of a firm consistence, and thick.

c. Membranaceous, *(membranaceus)*, when it consists of a thin, transparent tunicle.

d. Halved, *(dimidiatus)*, when only the half of the seed has a covering.

e. Torn, *(lacerus)*, when the arillus is irregularly laciniated, fig. 206.

f. Caped, *(calyptratus)*, when it covers the top of the seed, as the calyptra surrounds the the top of the theca in Mosses, (§ 113).

* In the animal kingdom there has indeed been discovered a leech, *(hirudo octoculato)*, which produces one egg, and from this proceed eight, ten, or more young. But it may be questioned whether this is really a single egg, or whether it is not several connected together by some mucilaginous matter. In plants there is no instance of this known to me

g. Net-like, *(reticulatus)*, when it closely embraces the seed like a fine web. Examples of this are found in the species of Orchis, and particularly in all very small seeds. In these plants the seeds are enclosed as in a bag*.

2. The PAPPUS is the calyx of each particular floret enclosed in a common perianth, (§ 77.) During the time of flowering, the pappus is in most plants so very small that its distinguishing characters cannot well be observed; when the seed ripens it attains its perfection, and then exhibits the following varieties:

a. Sitting, *(sessilis)*, when the pappus sits on the the top of the seed, without any foot-stalk, fig. 189.

b. Stipitate, *(stipitatus)*, when it is supported on a pedicle, fig. 185, 186.

c. Abiding, *(persistens)*, when it is so closely attached to the seed that it does not fall off.

d. Caducous, *(caducus* s. *fugax)*, when it falls off upon the ripening of the seed.

e. Calycled, *(calyculatus* s. *marginatus)*, when a membranaceous rim rises over the seed: this is either,

α. Whole, *(integer)*, when the rim is not indented, and surrounds the top of the seed, as in Tanacetum, Dipsacus; or,

* The Arillus does not surround the seeds alone; sometimes it even encloses the pericarpium, as in the nutmeg, Myristica *moschata;* what is called mace is an arillus which surrounds the fruit, fig. 206.

β. Halved, *(dimidiatus)*, when the rim surrounds only the half of the top of the seed.

f. Chaffy, *(paleaceus)*, when small leaves like scales stand round the top of the seed, as in the sun-flower, Helianthus *annuus*, and many others. This chaffy pappus consists of two, three, five, or more leaves, *(di, tri, penta*, vel *polyphyllus)*; the foliola are lanceolate, obtuse, or setaceous.

g. Awned, *(aristatus)*, when one, two, or even three, but never more, straight setae stand round the top of the seed, as in Bidens *tripartita.*

h. Stellate, *(stellatus)*, when five long-pointed bristles are spread like a star on the top of the seed.

i. Hair-like, *(capillaris* s. *pilosus)*, when many very fine, and commonly shining, white, simple hairs stand on the crown of the seed, fig. 186.

k. Setaceous, *(setaceus)*, when many rigid bristles that are of another colour than white, and all of them quite smooth, surround the top of the seed, fig. 189.

l. Fringed, *(ciliatus)*, when stiff, close-pressed setae, are set with very short, and hardly visible hairs. This kind connects the former with the following species.

m. Plumose, *(plumosus,)* when the pappus is composed of fine hairs or setae, that are themselves set with fine hairs on the sides, fig. 185.

n. Uniform, *(uniformis)*, when all the pappi in a common perianth are of the same form.

o. Unlike, *(difformis* s. *dissimilis)*, when in a common perianth the pappi are of different forms.

p. Doubled, *(geminatus)*, when a pappus is composed of two kinds; for instance, when the pappus on the outside is calyciform, on the inside capillary or hairy; or on the outside calyciform, on the inside setaceous; or also on the outside calyciform, and on the inside plumose.

N. We must beware of confounding the hairs, which sometimes cover seeds, with the true pappus. In Eriophorum there is no true pappus, but merely hairs that surround the seeds: this is called *Lana pappiformis.*

3. The TUFT, *(desma* s. *coma)*, is a body that appears like a pilose pappus, and is not to be distinguished from it except by its origin. The coma is always attached to the seeds that are contained in a pericarp, and never occupies the place of a calyx, as in Asclepias *syriaca*, Epilobium, &c. fig. 168, 169.

4. The TAIL, *(cauda)*, is a long, thread-like body, that appears on the top of the seed, or of the utriculus, and is set with fine hairs, as in the pasque-flower, Anemone *Pulsatilla*, Clematis, and many others, fig. 164.

N. The seeds of the Typha *latifolia* seem to have a pappus; but it is at the top a smooth, straight cauda, and the seed is supported on a long stalk, that is set with hairs on the under part, like a pappus.

5. The ROSTRUM is a persistent style remaining on the seed, or on the pericarp, as in Scandix, Sinapis, &c. When the rostrum is crooked, it is called a horn, *(cornu)*, as in the capsule of Nigella *damascena*, and many others.

6. The WING, *(ala)*, is a cartilaginous, thin, transparent membrane, that is found on the top, on the back, or on the margin of the seed or of the pericarp. Of this there are the following varieties:

a. *Monopterygia*, when there is but one wing.
b. *Dipterygia*, s. *bialata*, when there are two wings, fig. 161.
c. *Tripterygia*, s. *trialata*, three wings.
d. *Tetraptera* s. *quadrialata*, four wings.
e. *Pentaptera* et *polyptera* s. *quinquealata* et *multialata*, with five or many wings. This kind is found in many capsules, and in the seeds of some umbelliferous plants. The seeds likewise of umbelliferous plants that have many wings are called *semina molendinacea*.

N. To this term is also to be referred the membranaceous transparent margin, *(margo membranaceus)*, which surrounds some pericarps and seeds.

7. The CREST, *(crista)*, is a thick, coriaceous or cork-like wing, indented or deeply split, that appears

on the top of some pericarps, as in Hedysarum *Crista galli.*

8. The RIBS, *(costa* s. *jugum)*, are very prominent ridges, that are seen in some pericarps, and on the seeds of umbelliferous plants.

9. The WART, *(verruca)*, is a small, obtuse, round eminence, found on many seeds.

10. HOARINESS, *(pruina)*, is a fine white powder, that often covers the seeds and the pericarp, as in the plumb, Prunus *domestica*, &c.

11. The SPRINGER, *(elater)*, is a filiform elastic body found on the seeds of the Musci hepatici; as, Marchantia, Jungermannia,, and which throws them to a distance. It has in general, when observed with a magnifier, the appearance of a small chain, whence it has sometimes been called also *Catenula.*

12. The HAIR-NET, *(capillitium).* This is a reticulated collection of hairs that serve to fasten the seeds of some species of Fungi, such as Trichia, Stemonites, &c. fig. 301.

13. The GROUND-BRISTLE, *(trichidium* s. *pecten)*, is a very tender, simple, and sometimes branched hair, which supports the seed in some Fungi, as Lycoperdon, Geastrum*.

§ 118.

The BASE, *(basis)*, is the part on which the whole flower stands, and the fruit too, when the flower has

* With regard to the surfaces and the covering that are proper to the pericarp and to the seeds, the terms mentioned in § 6. will serve. The seed is also in respect to its substance to be found from the hardness of bone to the consistence of a jelly.

faded. There are two kinds of base; viz. the Receptacle, *(receptaculum)*, and the Fruit-bed, *(thalamus)*.

The Receptacle is a body, more or less extended, on the surface of which the flowers and afterwards the fruit stand; it is of two kinds, namely, the simple, *(proprium)*, which bears but one flower; and the common, *(commune)*, which bears several flowers.

§ 119.

The simple Receptacle, *(receptaculum proprium)*, is not much raised: it has commonly no greater surface than is necessary for the space occupied by the flower-stalk. Several plants, however, are an exception to this, particularly those that have many styles. In these it cannot be otherwise; a number of styles occupies a considerable space; and therefore the receptacle is sometimes flat, *(planum)*, sometimes arched, *(convexum)*, and sometimes spherical, *(globosum)*. But the most remarkable kinds are the dry, *(siccum)*, that is of a hard substance, and the fleshy, *(carnosum)*, that is soft and succulent, as in the strawberry, Fragaria *vesca*, fig. 213. This fruit is not a proper berry, but is a fleshy receptacle with free seeds. In a few plants that have but one style, the receptacle is uncommonly strong and fleshy, as in the cashew-nut, Anacardium *occidentale*, fig. 214. The fruit of this plant is a nut, that stands on a pear-shaped fleshy receptacle, as is the case likewise with the Semicarpus *Anacardium*, fig. 216. and Gomphia *japotapita*, fig. 215. But the most remarkable is a Japanese tree that bears small capsules, and the flower-stalk of which is so extremely thick and fleshy, that it has the appearance of a fleshy receptacle: it is the Hovenia *dulcis*, fig. 208.

Another kind of receptacle still is seen in unilocular capsules: it is found in the centre of these, is pyramidal, and of a coriaceous substance: this is called a spongy receptacle, *(receptaculum spongiosum)*.

§ 120.

The common Receptacle, *(receptaculum commune)*, is of wide circumference, and contains a multitude of flowers. It is of the following kinds:

1. Flat, *(planum)*, that is perfectly even, fig. 218.

2. Convex, *(convexum)*, that is somewhat elevated in the centre.

3. Conical, *(conicum)*, that rises in the centre into a high round point, fig. 221.

4. Clubbed, *(clavatum)*, that is much prolonged and resembles a club, as in Arum, fig. 42.

5. Closed, *(clausum)*, having the form of a ball or pear, internally hollow, and the flowers seated on the inner surface, as in Ficus, fig. 219, 220.

6. Quadrifid, *(quadrifidum)*, which is closed at first and formed like the last; but when the flowers, which stand on the inner surface, are perfectly formed, it bursts at the apex with four valves, as in Mithridatea *quadrifida*.

7. Flat, *(placentiforme)*, when a plane, broad receptacle is without a calyx, as in Dorstenia, fig. 123.

8. Smooth, *(glabrum)*, that is destitute of hairs or points.

9. Hairy, *(pilosum)*, that is set with stiff short hairs.

10. Villous, *(villosum)*, that is set with long, soft hairs.

11. Setaceous, *(setaceus)*, that is covered with stiff, bristle-like hairs.

12. Prickly, *(spiculatum)*, when it is covered with fleshy, erect, short points.

13. Warty, *(tuberculatum)*, when it is covered with small round eminences.

14. Punctured, *(punctatum)*, when the surface is covered with small, deep holes, fig. 218.

15. Scrobiculate, *(scrobiculatum)*, when there are deep round pits on the surface, 221.

16. Honey-combed, *(favosum)*, when large deep holes, like the cells in honey-combs, cover the surface.

17. Various, *(varium)*, when the common receptacle is smooth on the margin and hairy in the centre; or when the centre is smooth, the rim chaffy, hairy or prickly.

18. Chaffy, *(paleaceum)*, that is set with oblong, obtuse, short, hard leaves; these leaves are called chaff, *(paleae)*.

§ 121

The FRUIT-BED, *(thalamus)*, is a body more or less extended, enclosing in its substance the fruit, which cannot be seen till the former is separated from it. But if this is divided by thin vertical sections, the seed-cases may, by the help of a microscope, be seen in it. These seed-cases open on the upper surface of the Fruit-bed, and the seed is thrown out of very narrow openings in a manner visible to the naked eye. The following kinds of thalamus have been distinguished, viz.

1. The target, *(pelta)*, is a thin, round or oblong fruit-bed, which is chiefly found in the genus Peltidea, fig. 226. It is found commonly at the rim of the frond in these plants, and is covered by a tender skin, which becomes loose.

2. The shield, *(scutella)*, is a plate-shaped fruit-bed, sometimes flat, sometimes convex, or even concave, furnished with a margin variously formed, which is proper only to the Algae, fig. 3.

3. The tubercle, *(tuberculum)*, is a convex fruit-bed, which has no raised margin, but which bends itself outwards; otherwise it is either round, or long, or irregularly formed. It is also to be seen in the Algae.

4. The *Trica* s. *Gyroma*; this has the appearance of a saucer, differing only in having concentric or irregularly raised lines running into one another on its surface. It is peculiar to the genus Umbilicaria.

5. The *Lirella*, is a linear shaped fruit-bed with a furrow in the middle. It is found in the genus Opegrapha.

6. The *Cistella* is shaped like a ball; its outer skin separates, and within it is filled with a powdery substance. When this is dispersed it appears hollow. It is found in some Algae, as Sphaerophorus.

7. The *Orbiculus* is a round fruit-bed, flat on both sides, in the substance of some fungi, as Nidularia.

II. OF CLASSIFICATION.

§ 122.

The human mind is unable to take in the various forms of the vegetable kingdom at one view: it must therefore have recourse to some contrivance in order to facilitate the acquisition of knowledge, and to satisfy its curiosity. It attains its object in the most perfect manner when it reduces its knowledge to a system.

A botanical system is a list of all the plants hitherto discovered, arranged according to certain characters, and their deviations from them. When a person has once accustomed himself to some system, his progress will be doubled, and he will form a much better judgment of plants than he was able to do before.

§ 123.

There have been men of high abilities who have maintained, that all nature might be reduced to system; there have, on the contrary, been other great men who have denied the truth of this position, and have rejected all systematic arrangement, or even the least trace of it. Others again, and indeed the greatest number, believe that there is no real system of nature but that there is a chain of beings.

Nature connects the most multifarious bodies by their form, size, colours, and qualities. Each individual body, each plant has some affinity with several others, and this goes on to infinity. But who is able to declare the order followed by nature? All affinities and natural arrangements are but apparent traces of a natural system. By a more accurate investigation, we find those boasted affinities not so great, and the natural arrangements not so luminous. We endeavour, by our systematic divisions, to arrange bodies in straight lines; but nature forms in the whole an intricate and infinite ramification, which we are too short-sighted to perceive, and too superficial to fathom. Perhaps in some centuries hence, when every corner of the globe has been examined, and multiplied experience has distinguished what is true from what is false, we may be able to judge more soundly of the order of nature.

§ 124.

But though a true natural system has not been discovered, it cannot be denied that some plants are allied by such very striking resemblances, that they may be considered as belonging to natural classes. Those resemblances, however, extend but to few plants, and there are many wanting to connect one natural family with another. These affinities, however, have been sufficient to enable botanists to arrange plants by their external characters, and this arrangement has been called a Natural System, *(Systema naturale.)*

Other botanists have founded their systems on the number, proportion and agreement of minute and not very obvious parts, and such a system has been called Artificial, *(Systema artificiale.)*

Others again select the sexual parts as the distinctive characters, and found their system on the number and variety of these parts. This is called the Sexual System, *(Systema sexuale.)*

§ 125.

Some of those natural families of plants, which the beginner ought to be well acquainted with, are the following:

1. The FUNGI; these are distinguished from other plants by their peculiar form, which is commonly fleshy, coriaceous, or woody, fig. 4, 6, 7, 223, 224, 225.

2. The ALGAE come somewhat nearer in their appearance to other plants; but neither stem nor leaves are to be found in them. Their form is very various; sometimes they have the appearance of flour or fibres; or they resemble the fret-work in architecture, fig. 3, 226.

3. The MUSCI, Mosses. In these the external appearance is almost the same with that of other plants, but their fruit and leaves are different. They are divided into,

a. Musci frondosi: these have a capsule which is furnished with a lid, and the leaves are small, fig. 138.

b The *Musci hepatici:* these in general have no stem; their leaves grow larger, and lie flat. The capsule bursts into several valves, fig. 127.

4. The FILICES, Ferns, are plants that never push from the root more than one leaf on a foot-stalk, (some Indian species excepted), and the leaf at its evolution is generally rolled up in a spiral. Their fructification is either in a spike, *(spiciferae)*, fig. 9, or on the back of the leaf, *(epiphyllospermae s. dorsiflorae)*, fig. 15.; or lastly, on the root in the form of a knob, *(rhizospermae)*.

5. The GRAMINA, Grasses. These have their leaves long and slender, their stem, which is called straw, is commonly jointed, and each flower bears but one seed: the flower likewise is very different from that of other plants, fig. 34.

6. The LILIA, Lilies, have bulbous or tuberous roots, long, slender leaves, specious flowers, without calyx, or instead of it a spatha.

7. The PALMAE, Palms; these have an arboreous stem, but never branches; the leaves rise from the stem, which is called *stipes*. The flowers issue from a spatha.

8. PLANTAE, Plants, are all that do not come under the above divisions; they are either Herbs, Under-shrubs, Shrubs, or Trees.

a. Herbae, are all such plants as bear flowers and seeds but once, and then die. They do this either in one year, and are then called Annuals, *(plantae annuae;)* or they bear in the first year leaves, in the second flowers and seeds, and then die: these are called biennials, *(plantae biennes.)*

b. Under-shrubs, *(suffrutices)*: in these the stem perishes annually, but the root remains.

c. Shrubs, *(frutices)*: of these the stem continues many years, and is divided below into branches.

d. Trees, *(arbores)*: of these the stem endures for many years, and is divided at top into branches.

Climate and culture have great influence on these divisions; so that often trees and shrubs insensibly run into one another.

§ 126.

Before we proceed to treat of the different systems, it is necessary to explain what is meant by Class, Order, Genus, Species and Variety.

A System is first divided into classes and orders. In each system a certain part of plants, such as the flower, the fruit, &c. is assumed as the foundation, and upon that, classes, orders, and genera are constructed. When a particular investigated character is common to many plants, these plants make a Class, *(classis)*. Should some of the plants, beside the particular character of the class, agree in another character, these form an Order, *(ordo)*. And if a few of the plants, which already agree in two of the characters, are found to possess others in common, these are called a *Genus*. Each of the plants in this last division is called a *Species*. It is necessary in a species that it remain always the same from seed. A Variety, *(varietas,)* is a species that differs only in colour, size, or in some accidental circumstance. From the seed the variety changes at last into the true species. Of this more in § 185.

§ 127.

From a good system we expect that the part selected, according to which the classes, orders and genera are framed, shall be easily seen, and without difficulty found; and that it shall be common to all plants, and not subject to variation. Besides, no system ought to be divided according to any other character than that first selected. No good system should have too many subdivisions, and, if possible, should only consist of classes and orders. The orders should likewise be founded only on one part.

§ 128.

For a beginner it is very convenient to be acquainted with several systems, especially if at the same time he knows the defects of each, that he may be able, by his own experience, to have recourse to that which particularly suits him. I shall here give a view of the principal systems, in the language in which they were originally written; and should any term occur which is not to be found in the preceding Terminology, I shall briefly explain it.

§ 129.

Caesalpinus was the first botanist who invented a system. He selected the fruit, and the situation of the corculum, as the distinguishing characters. His system has fifteen classes, viz.

1. Arbores, corculo ex apice seminis.
2. ——— ——— a basi seminis.
3. Herbae, solitariis seminibus.
4. ——— ——— baccis.
5. ——— ——— capsulis.
6. ——— binis seminibus.
7. ——— ——— capsulis.
8. ——— triplici principio, fibrosae.
9. ——— ——— ——— bulbosae.
10. ——— quaternis seminibus.
11. ——— pluribus seminibus. Anthemides.
12. ——— ——— ——— Cichoraceae & Acanaceae.
13. ——— flore communi.
14. ——— folliculis.
15. ——— flore fructuque carentes.

This system is, for our times, when such a multitude of plants have been discovered, no longer of use. Considered as the first attempt at system it is entitled to great consideration. The fruit is a very constant part, and this classification would be particularly commendable, if plants and trees had not been separated. In the two first classes trees are distinguished according to the situation of the corculum; the other classes are arranged according to the fruit of the plants. The eighth and ninth classes have a trilocular capsule, and are distinguished according to the situation of the corculum; the other classes are arranged according to the fruit of the plants. The eighth and ninth classes have a trilocular capsule, and are distinguished according as the root is either fibrous or bulbous. The eleventh, twelfth, and thirteenth classes contain the compound flowers, (§ 72, No. 3); the twelfth, semifloscular flowers, (§ 72, No. 1); the thirteenth, discoid flowers, (§ 72, No. 2). The fourteenth class contains such plants as bear several capsules together, as the ranunculus, anemone, &c. The last class includes Mosses, Algae, Fungi and Filices. The ancients believed that these plants carried neither flowers nor seeds.

§ 130.

MORISON constructed his system according to the flower, and the external appearance of the plant. He has eighteen classes:

1. Lignosae, Arbores.
2. ——— Frutices.
3. ——— Suffrutices.
4. Herbaceae, Scandentes.
5. ——— Leguminosae.
6. ——— Siliquosae.
7. ——— Tricapsulares.
8. ——— a numero capsularum dictae.
9. ——— Corymbiferae.
10. ——— Lactescentes. *s.* papposae.
11. ——— Culmiferae *s.* Calmariae.
12. ——— Umbelliferae.

13. Herbaceae, Tricoccae.
14. ———— Galeatae.
15. ———— Multicapsulares.
16. ———— Bacciferae.
17. ———— Capillares.
18. ———— Heteroclitae.

The defect of this system, as of all the old systems, consists in the various foundations of the division, and in separating trees and plants. By Suffrutices, MORISON means small shrubs, but not according to our definition, (§ 125). Even some moderns use the term *Suffrutex* for a small shrub. The fourth class contains all twining plants, as the Cucurbita, Convolvulus, &c. The seventh class includes plants which have a trilocular capsule. In the eighth class are plants that have sometimes more, sometimes fewer cells in the capsules. The ninth class contains the compound flowers that have no pappus, or at least only a membranaceous one. In the tenth class are all the compound flowers that have a plumose, pilose, setaceous, &c. pappus. To the eleventh class belong all the grasses and plants allied to them; to the twelfth, the umbelliferous plants; to the thirteenth, those which have a trilocular capsule, (§ 104, No. 5). The fourteenth class contains the ringent or labiated flowers; the seventeenth contains only the Filices; and the eighteenth includes the Mosses, Algae, Fungi and Corals. It is to be regretted that MORISON often arranges plants in a class to which they do not belong.

§ 131.

HERMANN made use of the fruit, of the flower, and also, but on few occasions, of the external appearance, in framing his system.

Herbae gymnospermae.

1.	Monospermae.	Simplices.
2.	———————	Compositae.
3.	Dispermae.	Stellatae.
4.	———————	Umbellatae.
5.	Tetraspermae.	Asperifoliae.
6.	———————	Verticillatae.
7.	Polyspermae.	Gymnopolyspermae.

Herbae Angiospermae.

8.	Bulbosae.	Tricapsulares.
9.	Capsula unica.	Univasculares.
10.	Capsulae binae.	Bivasculares.
11.	——— tres.	Trivasculares.
12.	——— quatuor.	Quadrivasculares.
13.	——— quinque.	Quinquevasculares.
14.	Siliqua.	Siliquosae.
15.	Legumen.	Leguminosae.
16.	Multicapsulares.	Multivasculares.
17.	Carnosae.	Bacciferae.
18.	———————	Pomiferae.

Herbae Apetalae.

19.	Calyculatae.	Apetalae.
20.	Glumosae.	Stamineae.
21.	Nudae.	Muscosae.

Arbores.

22.	Incompletae.	Juliferae.
23.	Carnosae.	Umbilicatae.
24.	———	Non Umbilicatae.
25.	Non carnosae.	Fructu sicco.

This system is to be preferred to those already mentioned; only the separation of trees and plants is reprehensible. But to make it useful in the present times, it would need great amendment. The above enumeration of the classes renders any further explanation unnecessary.

§ 132.

CHRISTOPHER KNAUT has also chosen the fruit as the foundation of his system, but with this difference, that he has taken into account the number of the petals and the regularity of the flower. His system has a great resemblance to the first of Ray.

§ 133.

BOERHAAVE has constructed his system partly from that of Hermann, Tournefort and Ray. He too has separated trees and plants. The number of the capsules, of the petals, and of the cotyledons is made use of.

§ 134.

RAY conjoins fruit, flower, and external appearance, like his predecessors. As his system has something peculiar, I shall here detail it.

1.	Herbae,	Submarinae.
2.	——	Fungi.
3.	——	Musci.
4.	——	Capillares.
5.	——	Apetalae.
6.	——	Planipetalae.
7.	——	Discoideae.
8.	——	Corymbiferae.
9.	——	Capitatae.
10.	——	Solitario semine.
11.	——	Umbelliferae.
12.	——	Stellatae.
13.	——	Asperifoliae.
14.	——	Verticillatae.
15.	——	Polyspermae.
16.	——	Pomiferae.
17.	——	Bacciferae.
18.	——	Multisiliquae.
19.	——	Monopetalae.
20.	——	Di—Tripetalae.
21.	——	Siliquosae.
22.	——	Leguminosae.
23.	——	Pentapetalae.
24.	——	Floriferae.
25.	——	Stamineae.
26.	——	Anomalae.
27.	——	Arundinaceae.
28.	Arbores,	Apetalae.
29.	——	Fructu umbilicato.
30.	——	—— non umbilicato.
31.	——	—— sicco.

32. Arbores, Fructu siliquoso.
33. .... Anomalae.

The old system of Ray has only twenty-five classes, and is consequently more imperfect than this improved one. He still retains the old division of trees and plants. In the first class stand all the Fuci, Zoophytes, and Corals. In the fifth all plants that have no petals; in the sixth the semifloscular flowers, (§ 72, No. 1.); in the seventh the discoid and radiate flowers that have pilose pappus; in the eighth class are those same flowers, but which have no pappus; and in the ninth class stand all those capitated compound flowers which have a membraneous pappus. The twelfth class contains plants with verticillated flowers, that at the same time have a corolla of four petals and two naked seeds. Under the thirteenth class are arranged all the rough-leaved plants, that bear a monopetalous tubular corolla, and four naked seeds. To the fourteenth belong the labiated or ringent flowers. In the twenty-fourth class stand all the Lilies. To the twenty-fifth belong all the Grasses, and to the twenty-sixth those which cannot be reduced under any of the foregoing.

§ 135.

Camellus has attempted a very singular system, framed from the valves of the capsule and their number. It is not, however, on account of its shortness, of great use.

1. Pericarpia Afora.
2. .... Unifora.

3. Pericarpia Bifora.
4. .... Trifora.
5. .... Tetrafora.
6. .... Pentafora.
7. .... Hexafora.

§ 136.

RIVINUS selects only the corolla, the regularity of the petals, and their number.

Flores regulares.

1. Monopetali.
2. Dipetali.
3. Tripetali.
4. Tetrapetali.
5. Pentapetali.
6. Hexapetali.
7. Polypetali.

Flores compositi.

8. Ex flosculis regularibus.
9. Ex flosculis regularibus et irregularibus.
10. Ex flosculis irregularibus.

Flores irregulares.

11. Monopetali.
12. Dipetali.
13. Tripetali.
14. Tetrapetali.
15. Pentapetali.
16. Hexapetali.

17. Polypetali.
18. Flores incompleti.—Imperfecti.

This system is very easily understood, and the selected character is to be found without any trouble. But the regularity of the corolla, which often varies in the different species of a genus, and the number of petals, which likewise not unfrequently vary, make it difficult in practice. The orders are taken from the fruit according as it is naked, *(fructus nudus)*, or contained in a pericarp; and this last is distinguished according as it is dry *(pericarpium siccum)*, or *(pericarpium carnosum)*.

§ 137.

Christian Knaut has adopted Rivinus's method almost unchanged, but in some degree reversed. The classes he forms from the number of the petals, and his subdivisions he takes from their regularity or irregularity. But he denied that there were any flowers without a corolla, or that there was such a thing as naked seeds.

§ 138.

The System of Tournefort was for a considerable time the favourite system of all botanists, and it deserves particular attention.

Herbae et suffrutices.

1. Floribus monopetalis campaniformibus.
2. .... infundibuliformibus et rotatis.
3. .... anomalis.

4. Floribus monopetalis labiatis.
5. ——— polypetalis cruciformibus.
6. ——— ——— rosaceis.
7. ——— ——— umbellatis.
8. ——— ——— caryophyllaeis.
9. ——— ——— liliaceis.
10. ——— ——— papilionaceis.
11. ——— ——— anomalis.
12. ——— flosculosis.
13. ——— semiflosculosis.
14. ——— radiatis.
15. ——— apetalis et stamineis.
16. Qui floribus carent et semine donantur.
17. Quorum flores et fructus conspicui desiderantur.

Arbores et frutices.

18. Floribus apetalis.
19. ——— amentaceis.
20. ——— monopetalis.
21. ——— rosaceis.
22. ——— papilionaceis.

The form of the corolla, which Tournefort properly employs as the ground-work of his system, appears to make it very easy and intelligible. But the figure of the corolla is so various that it is often with difficulty described. Besides, some species of corolla so much resemble others that they are not easily distinguished. It is on this account chiefly that Tournefort's system is not used in these days. The orders in his method are taken from the style and from the fruit. When the germen is under the flower, he says "*calyx abiit in fructum;*" when it is included in the flower he says "*pistillum abiit in* "*fructum.*" The fruit is also more accurately distinguished, as it is a capsule, berry, &c.

§ 139.

We shall here pass by several of the less important systems that are merely alterations of the foregoing. These alterations consist sometimes of a single circumstance, of which the former authors had taken no notice. Of this PONTEDERA may serve as an instance. He took Tournefort's system, and combining it with that of Rivinus, only separated the plants that bear buds from those that have none. Another more worthy of consideration is that of MAGNOLIUS; though it too is of little use in practice. He forms his classes intirely on the calyx. Many similar systems may be found in ADANSON, an eminent naturalist, who has exhibited upwards of sixty systems, and has shewn evidently that many more might be formed, if science was to derive any benefit from the labour.

§ 140.

The systems we have detailed are either built on the fruit or the flower, and their parts: but none before GLEDITSCH had attempted one on the situation of the stamina. His classes are the following:

1. Thalamostemonis.
2. Petalostemonis.
3. Calycostemonis.

4. Stylostemonis.
5. Cryptostemonis.

The insertion of the stamina here forms the classes: in the first class they stand on the receptacle; in the second on the corolla; in the third on the calyx; in the fourth on the style; and to the fifth class belong plants whose flowers are inconspicuous, as the Filices, Musci, Algae and Fungi. The orders are formed according to the number of the antherae; that is, whether they are one or more in a single flower, *viz.* Monantherae, Diantherae, &c. But as there are so few classes, it is obvious that the orders must have many subdivisions; and this is the only objection to this, otherwise, very elegant system, which stands in the way of its further usefulness.

The same system has been lately somewhat changed by Monch. His classes are,

1. Thalamostemon.
2. Petalostemon.
3. Parapetalostemon, *i. e.* when the stamina stand upon leaves similar to petals, which are found in the corolla.
4. Calycostemon.
5. Allagostemon, when the stamina stand alternately on the calyx and petals.
6. Stylostemon, when they stand on the style.
7. Stigmatostemon, when they are inserted in the stigma.
8. Cryptostemon.

The orders he has taken from the differences in the fruit; but as some classes were too large, he was obliged to take his subdivisions from other parts of the flower.

§ 141.

HALLER endeavoured, very ingeniously, to frame a natural system on the cotyledons, the calyx, the corolla, the stamina, and the sexes of plants. His classes, of which he afterwards found it necessary to make some little alteration, are the following:

1. Fungi.
2. Musci.
3. Epiphyllospermae.
4. Apetalae.
5. Gramina.
6. Graminibus affinia.
7. Monocotyledones Petaloideae.
8. Polystemones.
9. Diplostemones.
10. Isostemones.
11. Mejostemones.
12. Staminibus sesquialteris.
13. ——— sesquitertiis.
14. ——— quatuor. Ringentes.
15. Congregatae.

To the third class belong all the Filices. To the seventh all the Lilies: In the eighth class stand all those plants whose filaments exceed in number the segments or petals of the corolla three or four times. To the ninth class belong all those plants which have twice as many filaments as there are segments or petals in the corolla. To the tenth belong those that have the same number of filaments as there are segments or petals in the corolla. In the eleventh class are included all those plants whose filaments are fewer in number than the segments or petals of the corolla. To the twelfth belong all the cruciform plants; to the thirteenth, all the papilionaceous; and to the fourteenth, the ringent or labiated flowers with four stamina. The last class contains all the compound flowers. The orders in this system are taken from all parts of the flower and of the fruit.

Royen and Wachendorf have constructed similar systems, the first of which deserves the preference. But all these systems are attended with difficulty, on account of the various parts of plants which we must have constantly in view, and the great number of subdivisions which they necessarily require.

§ 142.

Linnaeus, in his System, has fixed upon the stamina as the foundation of his divisions.

1. Monandria,
2. Diandria,
3. Triandria,
4. Tetrandria,
5. Pentandria,
6. Hexandria,
7. Heptandria,
8. Octandria,
9. Enneandria,
10. Decandria,
11. Dodecandria,
12. Icosandria,
13. Polyandria,
14. Didynamia,
15. Tetradynamia,
16. Monadelphia,
17. Diadelphia,
18. Polyadelphia,
19. Syngenesia,
20. Gynandria,
21. Monoecia,
22. Dioecia,
23. Polygamia,
24. Cryptogamia.

From the first to the tenth class the stamina are numbered, fig. 95, 79, 115, 81, 153, 154, 110, 126. To the eleventh class belong all the plants that have from ten to nineteen stamina. To the twelfth class those plants which have many stamina inserted in the calyx, fig. 52, 53. The thirteenth class contains plants that have a great number of stamina from twenty to one thousand in one flower, fig. 116. The fourteenth consists of plants that have four stamina in one flower, of which two are longer than the rest, fig. 50, 51. In the fifteenth class stand those which have six stamina, of which two are shorter than the rest, fig. 145, 149. The sixteenth class contains plants whose filaments are connected and form a cylinder, fig. 56, 57. In the seventeenth class stand those plants whose filaments are united in two parcels, fig. 108, 109. To the eighteenth class belong those plants whose filaments are united in several parcels, fig. 150. In the nineteenth class stand those plants whose antherae are united in a cylinder. The twentieth class consists of those plants whose stamina stand upon the style; the twenty-first consists of flowers of different sexes, namely, male and female on one plant; the twenty-second, of male and female flowers, but so divided that one plant bears only male flowers, the other only female; the twenty-third has flowers of both sexes and hermaphrodite flowers together, so that the plant contains either male and hermaphrodite flowers or female and hermaphrodite flowers. To the last class belong all plants whose flowers are not visible to the naked eye, these are the Filices, Musci, Algae and Fungi.

§ 143.

The Orders in most of the classes are taken from the style, in some from the fruit, and in the last classes from the filaments. From the first to the thirteenth class the orders are taken from the style, viz. *monogynia* when there is only one style in the flower, fig. 114, 115, 116, 144, 153, &c. two, three, four, &c. styled, *(di, tri, tetra, &c. polygynia)*, according to their number, fig. 135. In general we count to six, and then say *polygynia*. If there should be several germens and but one style, the style only is numbered. The orders are never taken from the germens except when the style is wanting. The Orders of the fourteenth class are taken from the fruit; there are two, viz. *Gymnospermia* when the seeds are naked, and *Angiospermia* when they are contained in a pericarp. Those of the fifteenth class are, like the foregoing, taken from the fruit, with this difference, that here there are no naked seeds but a Siliqua, and the Orders are named according to the size of this, *siliculosa* and *siliquosa*. In the sixteenth, seventeeth, eighteenth, twentieth, twenty-first and twenty-second classes, the Orders are denominated according to the number of the stamina; in the 16th, 17th, 18th and 20th, they are numbered from Diandria upwards; in the 21st and 22d from Monandria.

The 19th Class contains none but compound flowers, except a very few. Linnaeus considers these flowers as a Polygamy, *(polygamia)*, and prefixes this word to the name of each Order in which the compound flowers are contained; for example,

Polygamia aequalis, when all the florets which a compound flower contains are hermaphrodites, and similar in form, whether they be ligulate or tubular, fig. 85, 143.

Polygamia superflua, when the compound flower is radiate, the disk bearing hermaphrodite florets, and the ray, fertile florets.

Polygamia frustranea, when the compound flower is radiate, the disk consisting of fertile, hermaphrodite florets, and the ray of barren female florets.

Polygamia necessaria, when the compound flower is radiate, the disk consisting of barren hermaphrodite florets, the ray of fertile female florets.

Polygamia segregata, when in a compound flower besides the common perianth, each floret is furnished with its own particular calyx.

Monogamia is an Order containing all the plants which according to strict system belong to this class, though they are not compound flowers.

The plants of the 21st and 22d classes, as we have said already, are divided into Orders according to the number of the stamina; but besides these, here are two orders taken from the connection of the filaments and antherae, namely, *Monadelphia* and *Syngenesia*. The last Order of both classes is called *Gynandria;* not because in the plants which belong to it, the stamina stand upon the style; but because in the male flowers there is a production resembling a style to which the stamina are attached. This production Linnaeus considers as an imperfect pistillum.

In the 23d class the Orders are called *Monoecia, Dioecia* and *Trioecia.* The last class has the following Orders, *Filices, Musci, Algae* and *Fungi,* (§ 125).

§ 144.

From the aforegoing analysis it will be seen that the Linnaean system consists of an artificial and sexual arrangement, and that it does not answer the idea, we have given above, (§ 127), of a perfect system. But till such a one is found out, a system partly natural, partly artificial is the best; we must, however, as we cannot deny the usefulness of Linnaeus's system, point out its defects.

Linnaeus endeavoured, from the number of the stamina, their various lengths, and different modes of connection, to unite a natural classification with an artificial one. Hence arose some faults, which would not have happened had he, at the same time, made use of the corolla as a character. For instance, in the fourteenth class are contained the labiated and ringent flowers; but because Linnaeus characterised it from the four stamina, two of which are shorter; there are some of these plants which must stand in the second class, and others in the fourth, though they properly belong to this class. In the same manner, all the papilionaceous flowers are referred to the seventeenth class; but the assumed character, viz. that the filaments are united into two sets, is not to be found in all these plants:

Many have the filaments united in one cylinder; and in the tenth class stand many plants with papilionaceous flowers. These two faults are not the greatest which may be attributed to this system: it is a more important objection that Linnaeus has numbered the stamina in the first classes without attending to their insertion, while in the twelfth he remarks that they are inserted in the calyx, and in the twentieth, that they stand on the pistillum. In the nineteenth class are comprehended all the compound flowers, and yet he drags into the last order of this class other plants whose antherae are only sometimes united. It is also to be regretted, that in the 21st, 22d and 23d classes Linnaeus has taken notice of different sexes in the same plant, which he had not done before; there being many plants in the former classes that properly belong to these.

§ 145.

These defects and some others, from which no system can easily be exempted, have suggested to several botanists the possibility of correcting them and making the system more useful. Among all the improvements of the Linnaean system, those by THUNBERG, seem to be the chief. He has reduced the number of classes to twenty, by referring the plants of the 20th, 21st, 22d and 23d classes to others, according to the number or connection of the stamina.

All the plants which stand in the 20th class ought to have the stamina placed upon the style; but the most of the plants arranged by Linnaeus in this class want these characters, the genus of Orchis alone excepted, (§ 46, No. 7). The three following classes are not always constant with regard to sex; a difference of climate will sometimes remove a plant from the class Monoecia to that of Polygamia.

LILJEBAD has made the following changes on the Linnaean system. He joins the 7th, 8th and 9th classes to the 10th. His Decandria thus contains the Heptandria, Octandria, Enneandria and Decandria of Linnaeus. The 11th class he joins to the 3th. The 18th, 21st, 22d, and 23d he includes in one. Thus his system contains only sixteen classes, viz.

1. Monandria,	9. Polyandria,
2. Diandria,	10. Gynandria,
3. Triandria,	11. Didynamia,
4. Tetrandia,	12. Tetradynamia,
5. Pentandria,	13. Monadelphia,
6. Hexandria,	14. Diadelphia,
7. Decandria,	15. Syngenesia,
8. Icosandria,	16. Cryptogamia.

Some other botanists have changed the orders of the 19th class, by leaving out the word *Polygamia*, and removing the plants of the order Monogamia to other classes.

But this order of the 19th class ought to be altogether suppressed; because the genera belonging to it have nothing in common with the other syngenesious flowers but the united antherae, which other genera, for instance, the Solanum, possess likewise. If this order be taken away the class becomes perfectly natural.

Schreber, in the last edition of the Genera Plantarum, has changed the Orders of the 24th class, as follows:

1. Miscellaneae.
2. Filices.
3. Musci.
4. Hepaticae.
5. Algae.
6. Fungi.

It would be superfluous here to take notice of other alterations which do not tend to the improvement of the science.

The last Order of the Nineteenth Class, Monogamia, I have omitted, and transferred the genera contained in it to the fifth Class, where there are many genera with united antherae to be found. The order Syngenesia in the 21st and 22d Classes I transfer to the Order Monadelphia, because the plants there enumerated have neither compound flowers nor united antherae.

The order Trioecia in the 23d Class I likewise strike out, and bring to the foregoing one, because the plants of that order have, for the most part, the same variety of sex. The orders of the 24th class I have totally changed and called them,

1. Stachyopterides,
2. Filices,
3. Hydropterides,
4. Musci,
5. Hepaticae,
6. Algae,
7. Fungi,
8. Gasteromyci.

1. The STACHYOPTERIDES at emerging have the frond straight, that is, not rolled up, and their fruit stands either on a spike, or between the leaves. Their appearance, even when the fruit is not supported on a spike, resembles that mode of fructification.

2. The FILICES have at emerging their frond rolled up, and their fructification is on the back of the frond, seldom in a panicle, and still seldomer in a spike.

3. The HYDROPTERIDES have a flat frond, which is not rolled up, except in Pilularia, and their fructification is seated on the root.

4. The MUSCI have a thickly foliated stem, and bear a Theca, (§ 113).

5. The HEPATICAE have a flat frond, and their capsule in general separates into valves.

6. The ALGAE have a frond variously formed, and their fruit is either lodged in a Thalamus, (§ 121), or placed under the covering membrane.

7. The FUNGI are of various appearance, fleshy, coriaceous or woody, and the fruit is lodged in their substance.

8. The GASTEROMYCI are hollow and intirely filled with seeds, seldom with thalami. (§ 121).

§ 146.

Besides the knowledge of different systems, it is very useful for a beginner to have some idea of the natural affinities of plants. He is thus, in the investigation of unknown plants, more easily led into the right track. We are indeed far behind in this branch of knowledge, and the little we know is very imperfect: but that little may be of great assistance to us in the investigation of plants, because botanists in their descriptions often make use of expressions by which plants of particular allied families are ascertained. Linnaeus has left us the following arrangement of Natural Orders:

1. *Palmae*, § 125, 7.

2. *Piperitae.* The flowers of this order are crowded into a close spike, as Piper, Arum, &c.

3. *Calmariae.* To this order belong all the Grass-like plants, which differ from the true Grasses by their unjointed stem, such as Typha, Sparganium, Carex, Schoenus, &c.

4. *Gramina.* All the proper Grasses, § 125. 5.

5. *Tripetaloideae.* These have either three petals, or the calyx has three foliola, as in Juncus, Alisma, &c.

6. *Ensatae.* Lilies, whose leaves are ensiform or sword-shaped, and their corolla, monopetalous, are of this order, as Iris, Gladiolus, &c.

7. *Orchideae*, whose roots are fleshy, but the flowers are either furnished with a spur or with a corolla of a singular construction, § 83. The filaments and style are united, and the germen is below the flower.

8. *Scitamineae* have a herbaceous stem, very broad leaves, a three-cornered, or at least a blunt-cornered germen, under a liliaceous corolla; as in Amomum, Canna, Musa, &c.

9. *Spathaceae*, are Lilies, which have their flowers contained in a large spatha; as in Allium, Narcissus, &c.

10. *Coronariae*, Lilies that have no spatha, but have a corolla with six petals; as in Tulipa, Ornithogalum, Bromelia, &c.

11. *Sarmentaceae*, that have very weak stems and liliaceous flowers; as Gloriosa, Smilax, Asparagus, &c.

12. *Oleraceae*, that have plain flowers, *i. e.* of no beauty, as in Blitum, Spinacia, Petiveria, Herniaria, Rumex, &c.

13. *Succulentae*, that have very thick, fleshy leaves, as in Cactus, Mesembryanthemum, &c.

14. *Gruinales*, have a pentapetalous corolla, several pistils and a long-pointed capsule, as in Linum, Geranium, Oxalis, &c.

15. *Inundatae*, grow under water with flowers of no beauty, as Hippuris, Zanichellia, Ruppia, Potamogeton, &c.

16. *Calyciflorae*, that have only a calyx, in which the stamina are inserted, as in Eleagnus, Osyris, Hippophae, &c.

17. *Calycanthema*. In these the calyx is seated on the germen or grows to it, and the flowers are very beautiful, as in Epilobium, Gaura, Oenothera, Lythrum, &c.

18. *Bicornes*, have the antherae furnished with two long, straight points or horns, as in Ledum, Vaccinium, Erica, Pyrola, &c.

19. *Hesperides*, these have strong ever-green leaves, sweet-smelling flowers, and many stamina, as in Myrtus, Psidium, Eugenia, &c.

20. *Rotaceae*, bearing a wheel-shaped corolla, as in Anagallis, Lysimachia, Phlox, &c

21. *Preciae*, that have specious flowers which appear early in the spring, as Primula, Androsace, Diapensia, &c.

22. *Caryophylleae*, those having a monophyllous tubular calyx, a pentapetalous corolla, ten stamina, and long ungues to the petals, as Dianthus, Saponaria, Agrostemma, &c.

23. *Trihilatae*, these have a style with three stigmata, and winged or inflated capsules, as Melia, Banisteria, &c.

24. *Corydales*. The flowers of these have either a spur, *(calcarata)*, or are of a singular form, as in Epimedium, Pinguicula, &c.

25. *Putamineae*, that bear fruit in a hard shell, as in Capparis, Morisonia, &c.

26. *Multisiliquae*, bearing many siliques, as in Paeonia, Trollius, Caltha, &c.

27. *Rhoeadeae*, that have a caducous calyx, and a capsule or silique, as in Argemone, Chelidonium, Papaver, &c.

28. *Luridae*, that have commonly a monopetalous corolla, a pericarpium and five stamina. They are endowed for the most part with poisonous or dangerous qualities, as Datura, Solanum, &c.

29. *Campanaceae*; these have bell-shaped flowers, as the Campanula, Convolvulus, &c.

30. *Contortae*; in these the corolla is twisted, or the stamina and pistils are covered with leaves resembling petals; as in Nerium, Asclepias &c.

31. *Vepreculae*, have a monophyllous calyx, coloured like a corolla; as in Dirca, Daphne, Gnidia, &c.

32. *Papilionaceae;* these include the papilionaceous flowers, (§ 83. No. 5.); as Vicia, Pisum, Phaseolus, &c.

33. *Lomentaceae;* these bear a legumen or lomentum, but not a papilionaceous flower; as Mimosa, Cassia, Ceratonia, Gleditsia, &c.

34. *Cucurbitaceae*, whose fruit is a pepo or pumpkin, and in general they have united stamina, as in Cucumis, Bryonia, Passiflora, &c.

35. *Senticosae* have a polypetalous corolla, and the fruit consists of a number of seeds, either naked or slightly covered. The leaves and stems are either hairy or prickly, as in Potentilla, Alchemilla, Rubus, Rosa, &c.

36. *Pomaceae* have many stamina inserted in the calyx, and a drupa or apple for fruit, as Sorbus, Amygdalus, Pyrus, &c.

37. *Columniferae;* in these the stamina unite and form a long tube, as in Malva, Althaea, Hibiscus, &c.

38. *Tricoccae*, bearing a trilocular capsule, § 104, No. 5. as Euphorbia, Tragia, Ricinus, &c.

39. *Siliquosae*, bearing a silique or a silicle, § 110. as Thlaspi, Draba, Raphanus, &c.

40. *Personatae*, bearing a masked or personate flower, (§ 82. No. 13.), as in Antirrhinum, &c.

41. *Asperifoliae;* these have four naked seeds, a monopetalous corolla, five stamina, and rough leaves, as in Echium, Symphytum, Anchusa, &c.

42. *Verticillatae;* these have labiated or ringent flowers, as Thymus, Monarda, Nepeta, &c.

43. *Dumosae;* these are shrubby plants, and their stem is furnished with a soft medulla or pith; their flowers are small, the petals with four or five laciniae, as in Viburnum, Rhamnus, Euonymus, &c.

44. *Sepiariae;* shrubs, commonly with a tubular and laciniated corolla, and few stamina, in general only two, as in Syringa, Ligustrum, Jasminum, Fraxinus, &c.

45. *Umbellatae,* bearing an umbel of flowers, a pentapetalous corolla, five stamina, two styles, and two naked seeds; as in Apium, Pastinaca, Daucus, &c.

46. *Hederaceae;* these have a quinquefid corolla, five or ten stamina, and fruit like a berry, on a compound racemus; as in Hedera, Panax, Vitis, Cissus, Aralia, Zanthoxylon.

47. *Stellatae;* these have a quadrifid corolla, four stamina, and two naked seeds. The leaves are commonly verticillated; as in Galium, Asperula, Valantia, &c.

48. *Aggregatae;* these appear like compound flowers, but have no united antherae; as Scabiosa, Cephalanthus, &c.

49. *Compositae;* this order contains all the compound flowers; *vide* § 72.

50. *Amentaceae;* this contains those plants whose fruit is a catkin; *vide* § 40.

51. *Coniferae;* this contains those that bear a strobilus, § 113; as Pinus, Juniperus, &c.

52. *Coadunatae;* those which bear several berries or similar fruit united in one, as in Annona, Uvaria, Magnolia, &c.

53, *Scabridae*, that bear rough leaves and flowers of no beauty, as Ficus, Urtica, Parietaria, Cannabis, &c.

54. *Miscellaneae;* to this order belong all those plants which cannot be referred to one or other of the aforegoing.

55. *Filices*, § 125, No. 4.

56. *Musci*, § 125, No. 3,

57. *Algae*, § 125, No. 2.

58. *Fungi*, § 125, No. 1.

Many of these natural families are very artificial, and some of them quite improper; but most of them have in their external appearance a great resemblance, which we easily comprehend, but which it is not easy to describe. Some of these natural orders have been improved and extended. The most successful labourers on the subject have been Batsch and Jussieu, but especially the latter.

Batsch has established 77 families, which, with a few exceptions, are pretty natural. Jussieu, who had an opportunity of seeing a much greater number of plants, has described 100 families.

§ 147.

The above may suffice to give the beginner a slight idea of the most important systems: it is a general view which will shew us what remains to be done, and will convince us, that of the innumerable and endless varieties in the structure of plants, human ingenuity will never be able to contrive a perfect system.

III. BOTANICAL APHORISMS.

§ 148.

The true knowledge of Plants consists in the art of arranging, distinguishing, and naming them; and this art depends on the establishment of fixed rules, drawn from nature herself. The nature of arranging plants is called System or Classification, of which we have treated in the preceding chapter; but that of distinguishing them must be further elucidated. For this purpose we must have an accurate knowledge of the Terminology, that we may be able to apply it properly, and to employ the rules which have been framed from a consideration of the structure of plants. This knowledge is to be acquired by an accurate investigation of flowers and a frequent inspection of plants generally considered. Method, *(methodus)*, or the knowledge of plants from a consideration of the flower and its internal structure, is the proper business of a botanist; but the knowledge of the external figure, *(habitus)*, is an assistance for facilitating the former, which he must on no account neglect.

§ 149.

The flower and fruit are the most constant parts of plants, and therefore on them should a System be built, and from them should the characters be selected. Some botanists have employed the leaves for this purpose; but experience shows how fallacious such a system proves. As the flower is the chief foundation of System, it affords likewise characters for establishing the Genera. The Species, however, must be distinguished by other characters, (§ 186,—193), than those taken from the flower.

§ 150.

The first rule, which naturally arises from the foregoing observations, is this, that the characters of the class must never be the same with those of the orders, nor the characters of the orders the same with those of the genera; but that the genera, which stand under one order and class, must possess the characters of these without exception; as for instance the potatoe, *Solanum tuberosum*. This plant stands in the fifth class of the System of Linnaeus and first order: the characters of the fifth class are five stamina, and of the first order one style: the genus Solanum has the following characters: a quinquefid calyx, a wheel-shaped corolla, and a bilocular berry with many seeds. Thus if we place the discriminating character of the genus in its having five stamina and one style we would transgress the rule, for these characters are common not only to the genus Solanum, but to all those plants which stand under the same class and order*.

§ 151.

GENUS is a number of plants which agree with one another in the structure of the flower and fruit, (§ 123). To distinguish the genera, we describe the flower and fruit, and such description is called the *character*: this is threefold, the natural, the factitious, and essential, *(character naturalis, factitius, et essentialis)*.

The natural character, *(character naturalis)*, is a description at large of the flower and fruit of a plant, made according to the rules of Terminology, and serving for all the plants of a genus. Such a description it is very difficult to make; but when once accomplished, it tends to the perpetual ascertainment of the whole.

The essential character, *(character essentialis)*, is a very short description of the whole genus, which contains only the character which essentially distinguishes it from every other.

The factitious character, *(character factitius)*, is an essential character, but where the number of the parts or some other circumstances, not of essential importance, are taken into it.

The essential character is of great importance in the accurate investigation of a plant, and when it is

* There are, to be sure, some exceptions to this; for example, when there occurs an additional stamen or pistillum; but this exception will be noticed afterwards, (§ 162.)

obvious and distinct it throws great light on the knowledge of plants. The factitious character is only to be used when genera contain too great a number of species, so that it becomes necessary to subdivide them; but where it is possible this ought to be avoided.

The essential and artificial character must be included in the natural; when this is not the case some of them must be defective.

Keeping our former example of the Solanum, we shall, in technical language, exhibit its characters.

SOLANUM.

Calyx, perianthium monophyllum, quinquefidum, erectum, acutum, persistens.

Corolla, monopetala rotata. Tubus brevissimus. Limbus magnus quinquefidus, reflexo-planus, plicatus.

Stamina, filamenta quinque, subulata, minima. Antherae oblongae, conniventes, subcoalitae, apice poris duobus dehiscentes.

Pistillum, germen subrotundum. Stylus filiformis staminibus longior. Stigma obtusum.

Pericarpium, bacca subrotunda, glabra, apice punctato-notata, bilocularis. Receptaculo utrinque convexo carnoso.

Semina plurima subrotunda, nidulantia.

The above extended description is called a natural character, and is taken from the plant: any varieties of species are generally described separately. When we compare this natural character of the Solanum with others of the same class and order, particularly with the allied genera of Capsicum, Physalis, &c. the following discriminating character arises:

SOLANUM.

Corolla rotata. Antherae subcoalitae, apice poro gemino dehiscentes. Bacca bilocularis.

This essential character will easily distinguish the genus Solanum from the rest. But suppose there was found a plant which had all these characters, but had a berry that was quadrilocular; if we were to make of this plant a separate genus, the character would be factitious; for, as we shall show afterwards (§ 162, 163), the plant would notwithstanding belong to the genus Solanum.

§ 152.

Nature has connected, as we have seen, (§ 123), each particular plant with others, by certain affinities or resemblances. These resemblances are the foundation of the genera. But it is obvious that on this account the genera are not really in nature, but imagined by botanists, as assistances to the knowledge of plants. Genera must be founded only on the flower and fruit; but the resemblances which we observe in plants are not confined merely to these, but are found in every other part of the plant.

§ 153.

The establishment of genera is a necessary step in the science; and to attain the knowledge of them we must attentively consider the whole structure of the flower and of the fruit. This structure is either natural, *(structura naturalissima)*, or varied, *(differens)*, or, lastly, particular, *(singularis)*.

§ 154.

The structure is to be considered according to its number, *(numerus)*; figure, *(figura)*; situation, *(situs)*; and proportion, *(proportio)*: and by these we observe whether it is natural, varied, or particular. In genera we must always be attentive to number, figure, situation, and proportion; because without these no genus can be properly ascertained. On these are founded all the genera and most of the rules which, in the sequel, I shall lay down.

§ 155.

The natural structure, *(structura naturalissima)*, is that form of the fruit and flower which is most frequent. In the natural character it is not used; for it serves only as a rule for the other kinds of structure. The following is the most natural structure of the flower.

The calyx is green, shorter than the corolla, and thicker; the corolla is tender, easily falls off, and is surrounded by the calyx. The stamina stand within the corolla, the antherae stand erect upon the filaments, the pistillum is in the middle of the flower.

As to number, the calyx and corolla are for the most part divided into five laciniae, the stamina are five with one style. The laciniae or foliola of the calyx and corolla are in general equal in number with the stamina.

The fruit always corresponds with the style; if there is but one pistillum, the fruit is unilocular; if there are more, there are more cells in the pericarp.

The form of the calyx in general is a cup with erect foliola; the flower is commonly more or less funnel-shaped; the stamina pointed; the pistillum is furnished with a slender and pointed style with a simple stigma.

With regard to proportion, the calyx is often about a third shorter than the corolla; the stamina and style are hardly longer than the calyx. As to situation, the calyx encloses the corolla, and the petals are alternate with the foliola of the calyx. The stamina stand opposite to those foliola. The pistillum stands on the top of the germen. The seeds rest on the receptacle.

In a natural structure it is further observable, that a monopetalous corolla has a monophyllous calyx, and that a polypetalous corolla has a polyphyllous calyx. The corolla and calyx are seated on the receptacle. In a polypetalous corolla the stamina stand upon the receptacle; in a monopetalous, they are inserted in the corolla itself.

This natural character ought never to enter into descriptions. It would, for example, in the natural character of the Solanum, (§ 151), be quite superfluous, to say, *Calyx corolla minor, viridis, foliaceus, corolla tenera, antherae pulvere flavo farctae, germen post florescentiam intumescens, &c.*; because all these circumstances are supposed in a natural description, where we expect to find only discriminating characters.

§ 156.

Our botanical knowledge would be very limited if nature confined herself to the natural structure, and had made all flowers and fruits according to one form. But the contrary is the case, and we are therefore enabled to acquire a more extensive acquaintance with the vegetable kingdom. Of this the Terminology will serve as a proof; it points out to us the deviations of plants from the natural structure; and these deviations, when we consider merely the flower and fruit, exhibit the varied structure, *(structura differens)*, of plants. This structure is the foundation of every genus; all genera and their characters depend on this structure and the natural one.

§ 157.

The particular structure, *(structura singularis)*, is that which is directly opposite to the natural one, and affords the most beautiful characters. When, for example, in a monopetalous corolla the stamina stand upon the receptacle instead of being inserted in the corolla, we call that a singular structure; or when the nectaria stand between the corolla and the calyx, as in Wildenowia, instead of standing, as is usual, between the corolla and the stamina.

Some other examples are delineated on the fifth plate, which I shall here more particularly mention:

The genus Cucullaria, fig. 112, 113, shows an orchideous flower, with the anthera inserted into a petal.

The genus Rupala, fig. 115, has the filaments standing at the point of the foliola of the calyx.

The genus Lacis, fig. 116, has neither calyx nor corolla, but a very simple flower, consisting of many stamina and one style.

Dimorpha, fig. 126, appears with a single petal, rolled up on the side.

Dorstenia, fig. 123, has a common receptacle, set close with male flowers, fig. 124, and with female flowers, fig. 125; and has a particular calyx.

Sterculia, fig. 144, has a germen raised on a long foot-stalk, that is set with united filaments.

In the same manner are found the flowers of Periploca, Asclepias, and Stapelia; fig. 83, 88, 89, 90, 91, 92, 98, 99, 100. These are furnished with particular organs which we have described with the Nectaria, and which quite cover the stamina with the style. The stamina are singularly formed, the filaments are attached like forks to a cartilaginous body, and bear at the tip of each an anthera.

Two genera are remarkable for the particular structure of the floral leaf, namely Ascium and Ruyschia. The former, fig. 117, has an ascidiform stipitate floral leaf, *(bractea ascidiformis stipitata)*, which stands close behind the flower. The latter has an ascidiform sessile bractea, *(bractea ascidiformis sessilis)*, furnished with two lobes, *(biloba)*, which surround the flower behind.

These few instances are sufficient to show that the flowers above-mentioned have a particular structure, altogether different from the common one. Many o-other examples will be found by attentive dissection of flowers.

§ 158.

From the singular structure of plants may be deduced the aphorism, that those genera, which have this singular structure, are more easily ascertained than those that come near to the natural structure. This last extends over all the natural families of the vegetable kingdom. The umbelliferous plants, the lilies, the papilionaceous flowers, the cruciform and compound flowers, are, on account of the similarity of their structure, with difficulty distinguished. For ascertaining with facility the genera of every kind, rules have been laid down which must be adapted to new-discovered plants. There are rules which in general are applicable to all plants, and others that regard only particular families. But the genera are to be distinguished by the structure of the flower and fruit; not by that of the root, leaves, or inflorescence.

§ 159.

The flowers and their several parts have already been described in the Terminology; and that these are not constantly furnished with all the parts which constitute a perfect flower has also been mentioned, (§ 72). But there are cases, where, when the flower has only one external cover, it is difficult to determine whether that cover should be named calyx or corolla. It is therefore necessary to establish some rule to be made use of in doubtful cases, that we may not err in ascertaining a genus.

Hedwig was of opinion that the calyx and corolla should not be distinguished, but that both should have the same name. According to him the calyx should be named *Perigonium externum*, and the corolla *Perigonium internum;* and in cases where there is a double calyx, the inner one should be called *Perigonium intermedium.* In doubtful cases this might do very well; but where both parts are present it would give us no accurate idea of their form.

Scopoli proposed, to avoid any mistake, that when one part only was present, it should have the name of calyx. But this rule errs against all analogy; for Lilies have but one part, which is very delicate, and which, by any person the least acquainted with plants, would be considered as a corolla.

Linnaeus gives the following rule in this case: When one part only is present, and the stamina stand opposite to the foliola or their lacinae, he calls this a calyx; but when they stand alternately with these, he calls it a corolla. In a plant which has few stamina, and no more than there are laciniae or foliola in the part present, this rule, which is founded on the natural structure of flowers, may answer the purpose; but when the number of stamina is double, or greatly exceeds that of these laciniae, the rule can be of no use. In such cases, that part which is shorter than the stamina, of a green colour and firm substance, should be named calyx; but if it be longer than the stamina, if it be coloured, and of a tender substance, and does not remain till the maturation of the fruit, it is to be called corolla.

§ 160.

In constructing new genera, it is necessary, *that the essential character be applicable to all the species of the genus, and be subject to no variation.*

As the flower and fruit of one species are formed, so must those of all the rest be. For example, the fruit of one cannot be a berry and of another a drupa, though Linné has committed this mistake in the genus Rhamnus, which properly makes two distinct genera, namely, Rhamnus and Zizyphus.

§ 161.

The character of a genus must be formed from the number, figure, situation and proportion, (§ 154), *of the flower and fruit.*

It is only these circumstances, taken together, that constitute genera; taken separately, they are of no consequence. There are often species, which deviate from the generic character in this or that particular; but on that account they are not to be considered as distinct genera.

§ 162.

Number alone can never constitute genera, and must never be considered as of any importance.

Nothing is more subject to variation than the number of the stamina. They are often very various in the same genus. Some plants, when they grow in a rich soil, acquire one or two additional stamina and even additional petals. Often they are found with double the number of stamina they ought to have; for instance, a plant has ten stamina that should only have five; or contrariwise, it has only five stamina when it should have ten. Two often vary into four, three into six, four into eight, five into ten, six into twelve; in this way the number is either increased or diminished. When the structure of the other parts perfectly corresponds with another genus, and differs only in the number of a part of the flower, whether it be calyx, corolla, stamina or style, it would be improper on that account to make it a new genus.

§ 163.

When the number in all the parts of a flower is constant, it may be used as a subordinate generic character, but with great caution.

This rule must be used with great prudence. If it can be avoided, number must not be resorted to. Linné has given one example of this rule in the genera of Potentilla and Tormentilla. Number distinguishes these two artificial genera: the first has a double pentaphyllous calyx and a pentapetalous corolla. The calyx and corolla indeed remain constant in their number in both genera; but this example ought not to be imitated.

§ 164.

The monophyllus and polyphyllous calyx may constitute genera; but not the number of the laciniae *or leaves. The same thing may be said of the corolla.*

There are some families in which the calyx is of importance; but in these the number of the laciniae or foliola is not taken into account. If two plants resemble one another, but the one has a monophyllous and the other a polyphyllous calyx, they must be considered as different genera. The reason of which is, that a monophyllous calyx never changes into a polypetalous one; but the number of the foliola of a polypetalous calyx, or the number of laciniae in a monophyllous one may be subject to variation. The same rule applies to the corolla.

§. 165.

The number of the stamina must be ascertained by that of the greatest number of flowers; but if the flower first evolved differs in number of stamina from the rest, we must reckon by it.

The flowers of some plants are not always constant in the number of stamina; in this case we must be guided by the greater number; after, however, examining a considerable quantity of flowers. Sometimes, indeed, there appears a variety in the number of stamina, the first evolved flower having more than the rest. In this case we must reckon by the first flower, as it is in general the most perfect. In numbering the stamina it is likewise adviseable to consider its affinity with other plants. As examples, we refer to Ruta, Monotropa, and Chrysosplenium.

§ 166.

Too many genera are not to be made.

This rule is one of the most important. Many genera are a manifest disadvantage to the science. Generic differences are not too nicely to be sought for. It is the first duty of a botanist to make the science as easy and attainable as possible; but by a too refined exhibition of generic distinctions he will do it more harm than good.

If we consider as essential every small variation in the structure of flower and fruit, the number of genera will be multiplied, and the difficulty of the science increased. To this fault those are most prone who have seen fewest plants. When they have seen more, they will discover the intermediate plants which unite the different genera, and thus be forced to join what they formerly separated. I shall only here specify the genus Fumaria, several species of which have a differently formed pericarpium, but which, by a judicious arrangement, all run into one another. Linnaeus himself has sometimes distinguished too nicely; the difference he makes between Prunus and Amygdalus is improper; when examined strictly by the foregoing rule, these genera ought to be joined.

§ 167.

The external appearance, (habitus), *of all the species of a genus, must likewise be attended to, but no generic characters taken from it.*

This rule is to be taken with many restrictions, lest by too rigid an adherence to it the science may be injured. In new genera we must take care that the habit does not agree with that of other genera; for it often happens that a plant, supposed to belong to a new genus, belongs to one already known, and varies only in the number or figure of the parts of the flower.

When a plant agrees in flower and fruit with those of a genus already established, but is of a very different habit, it must not on that account be separated. An example will illustrate this: suppose a person to discover a plant, which in flower and fruit was a perfect Tilia, but had an herbaceous stem and pinnated leaves: however much the habit might differ from that of the other species of Tilia, the plant ought to be referred to that genus. This example is not really found in nature, but similar ones are frequent. To exemplify the rule I shall, however, take a real instance from the same genus. There is a tree in North America whose fruit agrees with that of our Tilia, but in the flower there appear besides the petals, small petal-like scales; the habit, however perfectly agrees with that of the limetree; and as the flower differs only in that inconsiderable circumstance, the plant is properly referred to the genus Tilia.

§ 168.

The regularity of the flower is no certain generic character.

The relative length of the petals is not always constant, and therefore affords no proper generic distinction. Suppose plants were discovered that differed only from one another in the irregularity of the flower, how undetermined would the science of Botany become, if the genera were to be multiplied from so trivial a circumstance!

§ 169.

The figure of the flower is always to be taken in preference to that of the fruit.

There are more genera, whose species agree in the flower, than there are whose species agree in the form of the fruit. The older botanists were too attentive to the fruit, which when it only differs in external figure is of little importance. In the genus Pinus we have an apt example. Formerly several genera were made of it, according as the fruit was round, or long, or pointed, or obtuse, &c. The number of the cells in a pericarp has likewise misled some botanists; but these alone can never be a discriminating circumstance; as number (§ 159) never affords generic characters.

§ 170.

Slight variations in the figure of the flower are of no consequence in establishing genera.

The form of the corolla is very various, as we know from the Terminology: but there are many kinds of it that very nearly resemble one another. This great resemblance shews evidently that the transition from one to another is but small, and that nature does not guide herself according to our distinctions. A funnel-shaped corolla easily passes into a salver-shaped one, and *vice versa ;* if genera were to be formed upon such small circumstances, the number would become too great. In the genus Convallaria, the species Solomon's seal, (C. *Polygonatum*), has a tubular, the lily of the valley, (C. *majalis*), a bell-shaped corolla. Hence we see that these trivial variations of allied species of corolla are of little consequence. But when plants with monopetalous and polypetalous flowers are allied, they must form separate genera. The form of the corolla must be very different when it gives occasion to form new genera.

§ 171.

Where the fruit in allied plants is very different, the genera must be separated.

Plants may agree perfectly in their flowers while they bear very different fruit. If the variety in the fruit does not rest on the number of the cells or of the seeds, or on the form of these alone, the plants must form distinct genera. The example already brought from the genus Rhamnus (§ 160), affords a proof of this. The genera Abroma and Theobroma differ only in the fruit. Such distinctions are very beautiful, and ought never to be overlooked.

§ 172.

The Nectarium affords the best generic character.

When the nectarium, on account of its singular figure, distinguishes one flower from another, it is an excellent character. But it must be remarked, that the structure of the nectary must be striking: for it would be improper to consider the Arenaria *peploides* as a distinct genus, because there are glands in the flower; or to separate the American Tilia, (§ 167), from the European, because there are small scales in the corolla. But if, as in other plants, there are nectaria of a cylindrical or filiform figure, such a singular structure ought not to be overlooked. The rule is not of difficult observation, for there are but few exceptions to it.

§ 173.

The figure of the style and of the filaments affords no generic character, except it is very remarkable.

It often happens, that the figure of the style and of the filaments in some species of a genus is very different; that the style and filaments are bent down, or are otherwise of a peculiar figure; but this, in general, is but of little importance. However, if in any genus there is an essential difference in these parts, as in Cordia, it deserves particular attention.

The germen may be supported on a stalk within the flower, as in Euphorbia, Passiflora, Helicteris, Sterculia, &c. which is a striking character not to be neglected. Linné was induced by this stalk, which is nothing more than an elongation of the receptacle, to consider it as another style below the germen; and he accordingly reduces various genera of this kind to his class Gynandria, (§ 142).

§ 174.

The situation of the germen is an excellent generic character.

However similarily constructed plants may be, if the germen in one is above, and in another is below the calyx, they must form separate genera. There is no instance known where this situation of the germen is subject to variation. A single exception is found in the genus Saxifraga; where in some species the germen is under the calyx; in some it is half above and half below, and in others it is wholly above the calyx. But here we see the transition distinctly, and consequently this instance alone is an exception to the rule.

§ 175.

The situation or rather the insertion of the stamina is of great importance in a generic character.

Whether the stamina are inserted in the calyx, in the corolla, or in the receptacle, they afford a principal character in establishing genera. Let the conformity of the whole plant or flower be what it may, the genera must be determined by the insertion of the stamina. In the caryophyllous plants, particularly in Lychnis and Silene, some filaments are inserted in the receptacle, and some in the corolla: these accordingly make one exception to the rule.

§ 176.

The sex (sexus), *of plants, can never serve as a discriminating character of a genus.*

If a plant differs from another in sex, this circumstance is not to be taken into the generic character, at least it cannot serve any important purpose. We have already remarked, that no character is more unsteady than that of sex; for hermaphrodite flowers are often by culture changed into male and female flowers, and even difference of climate produces the same effect. For instance, in our garden, the Ceratonia *siliqua* is constantly observed with perfect flowers, of different sexes on different trees, (Dioecia), though in Egypt it is constantly found with hermaphrodite flowers. Many genera, as Lychnis, Valeriana, Cucubalus, Urtica, Carex, &c. have species with hermaphrodite flowers, though all the rest are dioicous.

Flowers that are of neither sex, *(flores neutri)* having neither stamina nor style, and which are found between fertile flowers, as in Viburnum and Hydrangea, cannot serve as generic marks. The plants of the 19th class form the only exception.

Hitherto we have only stated the rules that are generally applicable to all the families of the vegetable kingdom. There are, however, particular rules for single plants that we must here take notice of. Whoever attends to them and to the rules already laid down, will find no difficulty in characterizing genera. Particular rules might be given for all the natural families, but it is sufficient to specify the most important.

§ 177.

The Grasses, (§ 125, No. 5), have too great a similarity in their whole structure not to make it necessary to select particular rules for ascertaining the genera. The number of the stamina, the presence or want of an arista, can by no means serve either for separating or for establishing genera. The number of the flowers, of the valves, and of the style, however, should not be neglected: there is hardly any thing else that affords better distinguishing marks than these; and, being steady, if they were to be overlooked, the genera would grow too large. The Involucrum, which is found in some grasses, affords various characters that ought not to be rejected, as does likewise the form of the valves and nectaria.

§ 178.

The Lilies, (§ 125, No. 6.), must be distinguished by the spatha, according as it is one or many-leaved, one or many-flowered: and also which happens in few other plants, the stigma, the duration of the corolla, and the direction of the stamina serve for distinguishing genera. We must likewise observe whether the stigma be divided, and how often; whether the corolla falls off, grows dry, or is persistent; lastly, whether the stamina are erect or bent down; or take an oblique direction. In this, as well as in the other natural families, the general rules already laid down are at the same time to be observed.

§ 179.

The umbelliferous plants, (§ 146, No. 45), have, of all the natural families, the greatest resemblance to one another. They are all furnished with a pentapetalous corolla, five stamina, an inferior germen, two pistilla; and even the mode of florescence and the fruit, which consists of two naked seeds, are similar. Linnaeus imagined he had found a discriminating circumstance in the general and partial involucrum, (§ 55), by which the genera were to be ascertained: but this part is subject to great variation, and can in very few cases afford a good character. Another difference has been found in the fruit. Though this always consists of two naked seeds, yet their figure is remarkably different; and upon this alone are founded the generic characters in the natural order of Umbelliferae.

§ 180.

In the labiated and ringent flowers, or the whole fourteenth class of the Linnaean System, (§ 142), the genera are established on the corolla, the calyx, and the direction of the stamina. In the first order, (§ 143), the fruit, which in the whole is similarly formed, affords no character, any more than the style, for in most the fruit consists of four naked seeds; the pistillum consists of a simple style and a bifid stigma. It is the laciniae of the calyx, the variously formed lips of the corolla, and, in a few genera, the direction of the stamina, which in most lie in the upper lip, that afford characters in this family. In the second order, (§ 143), the fruit, which is still more different, affords a number of characters for distinguishing genera. It is remarkable in this family, that some of the plants want a lip; those in the first order wanting the upper, and those in the last the under lip. Teucrium and Ajuga may serve as examples of the first order; Tourettia and Castilleja of the second. The Scordium of Cavanilles, which has an upper but no under lip, is an exception, as it belongs to the first order.

§ 181.

The cruciform flowers, or the plants belonging to the fifteenth class, (§ 142), on account of the great similarity of their parts, are with the greatest difficulty distributed into genera. It is the fruit alone which can distinguish them, and sometimes the nectaria in the flower; the calyx very seldom, and according as it stands out or is close applied. The corolla may likewise afford a distinguishing character, but is in all similarly formed, and the single genus Iberis appears with two petals shorter than the rest.

§ 182.

The Papilionaceae, or those of the 17th class, (§ 142), are likewise very similar both in flower and fruit. The calyx is in them the most important part. The characters from the corolla are less decisive; for they depend on the proportion of its particular parts, or on their situation. Such characters are not to be recommended, except where no better can be had, or when the situation and proportion are very remarkable. The connate stamina are of little importance, but the stigma makes a very proper distinctive mark. Whether the fruit in most of these plants be a legumen or a lomentum, it differs very much in figure: and according to the figure, cloathing, or number of the seeds it contains, may the genera be determined.

§ 183.

The compound flowers, or the 19th class, (§ 142), on account of their peculiar structure are subject to very different rules. In these, attention must be paid to the common perianth, the receptacle, and the pappus. On these are founded the genera of this whole family. The sex, which Linnæus employs in the orders of this class, (§ 143), cannot be approved of in distinguishing the genera, and still less the form of the flower. Many genera of this class that have no radius, nevertheless acquire it in favourable situations or in warm regions, and others in like manner lose it. A common plant with us, the Bidens *cernua*, according to the generic character should have no radius; but when it is found in very wet slimy ground, it grows radiate. Linné, who had seen both varieties, took the radiate plant for a particular genus, and called it Coreopsis *Bidens*. Hence it follows, that the genera Coreopsis and Bidens are not different, except their separation should depend on the trivial circumstance abovementioned. We might here bring forward several other examples, but they will easily be found upon attentive investigation.

§ 184.

The Cryptogamiæ, (§ 142), or the plants of the 24th class, whose flowers are not obvious to the unassisted eye, must be determined by their fruit. No character of these plants should be taken that requires a magnifier, and the character taken should be easily found. The flower of the cryptogamious plants is of such a kind that it can be seen only at a certain time, often for a very short period, and with a high magnifier: in some it has not yet been discovered at all. It would, therefore, be a very great error to select for a generic character a part not easily visible, and found with great difficulty. But the fruit is very easily seen, and may be examined with a moderate magnifier; so that it alone must give the character. We have not yet, however, sufficiently investigated the fruit in all the species of Cryptogamiæ: there are consequently several gaps in this class which remain to be filled up.

In the Filices, Linnæus has assumed the mode of inflorescence as the generic mark. In some of these the fruit stands in rows, in others in circles; sometimes in the centre, sometimes in the margin or in the angles of the leaves. In other plants this circumstance is of no use, but in the Filices we are obliged to resort to it.

The character which Dr Smith has chosen for discriminating the genera in the Filices is the Indusium, (§ 61). As this character is easily seen, he observes how it separates, and in what order the seed-capsules under it are placed. In other Filices, that have not their fructification on the back of the leaf, we must resort to the figure of the fruit.

The Musci frondosi, (§ 125), have of late been very accurately investigated, and their flowers and fruit are known: we are therefore now able to distinguish their genera better than formerly, the characters of which are taken from the peristoma, (§ 113. d). This organ affords a number of characters, that are steadily and easily seen.

The Musci hepatici, (§ 125), are also arranged in genera by the fruit, according to the mode in which it opens.

The Algae, (§ 125), have their genera ascertained according to the form of the fruit, so far as this is known; but the external form must not be employed for this purpose.

The Fungi, (§ 125), when their fruit has been discovered, will be distinguished by it; but where that is unknown, or does not afford sufficient characters, we must have recourse to their external appearance.

§ 185.

A SPECIES means each particular plant standing under a genus, which continues unchanged when raised from seed. A VARIETY, *(varietas)*, is a plant differing in colour, figure, size or smell from a known species, which easily by seed returns to the particular species it arose from. Species that require great attention to be distinguished from one another, but which constantly remain the same when raised from seed, are easily mistaken for varieties; and on account of the great resemblance they have to one another some botanists give them the name of SUBSPECIES. But all these may be determined by the simple division into Species and Varieties, and as this division is easily understood, it seems superfluous to descend to Subspecies. Varieties must not be confounded with monsters, (MONSTRA); these are, it is true, varieties, with this difference, that they are not continued by seed. Diseased plants have likewise sometimes the appearance of varieties; but they are easily distinguished, as we shall see hereafter. The various rules, according to which species are to be ascertained, are not founded on the flower or fruit, but upon other parts of the plant.

§ 186.

In distinguishing species regard is not to be had to colour, smell, taste, size, or to the external surface, viz. *whether it be smooth or hairy.*

When two plants differ from one another only in the colour of the flower, in having a different smell or taste, in one being a foot, and the other a cubit high; or in the one having a smooth and the other a hairy leaf or stem; such plants can be considered merely as varieties. If one plant differs from another in all these qualities together, it may pass for a different species.

White or black spots on the leaves of the plant cannot discriminate species, and should only be taken into account when plants really different cannot be distinguished otherwise. But if a species can be ascertained without having recourse to colour, it is always better.

Smell and taste, as they are only comparative qualities, cannot be received as specific characters.

The size depends so much on the quality of the soil that no regard can be had to it. The pubescence is exactly in the same circumstances; for a hairy leaf will become smooth in a different soil.

Plants with tomentose, spiny, or woolly leaves, or stalks, are not so easily considered as Varieties, and these qualities afford the best distinctions.

§ 187.

The root gives a beautiful and infallible mark for distinguishing spe ies.

When the root in two similar plants is different, they may be considered as different species. Cultivated plants are indeed an exception. Culture for a length of time, or the skill of a gardener, often give plants a very different appearance, as in the carrot, (Daucus *Carota*). In its wild state this plant has no large or yellow roots; it receives these only from culture. But the above rule is applicable solely to wild plants; however, if we can avoid drawing the specific character from the root, and can take it from other marks, it is so much the better; as we have not always an opportunity of examining the root, particularly in a hortus siccus.

§ 188.

The stem affords a certain and obvious specific distinction.

The stem seldom varies, and therefore gives an excellent character; in particular the round stem, the cornered, the jointed, the creeping, &c. are very steady. The branched stem is not so sure a mark; it is very subject to variation, and therefore gives no certain character.

§ 189.

The duration of a plant is a proper distinguishing mark of the species only in its native situation.

When allied or very similar plants differ in duration, so that one is an annual, the other a shrubby plant, or even tree, they must be considered as different species. But the duration of these, in the places where they grow wild, must be investigated. All plants that are biennial with us are annual in warmer climates. Some that are perennial in warm countries turn annual with us: the root is killed in our winters, and it must be restored by sowing it again. Other perennial plants with us are shrubs in warm countries, because no cold destroys their stems. When thus the duration of a plant exhibits any discriminating mark, the other species must be accurately examined to know whether they too are not of longer duration in a milder climate. But if plants vary in this respect in the same region, such must be considered as different species; for example, the Mercurialis *annua* and *perennis* resemble one another much, but the names express a distinct specific difference.

§ 190.

Most plants are distinguished from one another by their leaves.

Almost all plants are distinguished by the various form of their leaves. But there are instances where this character will not answer; for the umbelliferous, the compound, all the aquatic plants, figs, and mulberries are an exception. In these the leaves are subject to such considerable variations, that without much experience it is difficult to distinguish a species from a variety. When, therefore, there is uncertainty in the leaves, other characters must be resorted to.

§ 191.

The props, (fulcra), *present certain specific characters, which are to be preferred to all others.*

When plants differ from one another by their spines, stipulae or bracteae, they may be considered as distinct species. But it is to be observed, that these parts, if taken as specific characters, must not be subject to fall off.

§ 192.

The thorn, (spina), *and the tendril,* (cirrhus), *are always to be taken as certain characters.*

The thorn is nothing more than an indurated imperfect bud, which, when the plant grows in a luxuriant soil, changes to a branch. Pears, oranges, and other plants in a poor soil produce thorns, which leave them in richer ground. Some plants that have many thorns, retain them even in fertile soils. The prickle is very constant, and is never altered by change of soil. In the same manner the tendril changes in some plants with papilionaceous flowers. We must first be perfectly certain that the thorn or the tendril are never wanting before we distinguish the species by them.

§ 193.

The mode of inflorescence is the most certain character.

We have no instances of the mode of inflorescence being subject to variation. When plants differ in this respect they are undoubtedly different species. The number of the flowers, that is, whether they be two, three or more, is an uncertain character. In general it may be observed, that nothing is so inconstant as number, and that it ought never to be founded on.

§ 194.

A species is never to be made a variety, nor a variety a species, on account of any small difference.

We shall see by the history of our science, that in the 17th and in the beginning of the 18th century, every inconsiderable variety of a plant was made a species, which led to great error. It is a rule, rather to take a plant for a variety than to make it too easily a species.

A very different species may also appear a variety, and therefore we must try it carefully by all the aforegoing rules; and if there still remain any doubt, we must set it down where we think it is most probable it should stand, with a point of interrogation after it.

§ 195.

The selected characters of a species must be conspicuous, in the varieties.

If a plant is subject to great changes, the characters must be so chosen that they may be seen in all its varieties. It would, therefore, be faulty to separate a plant that commonly has a five-lobed leaf, and varies with an entire leaf, from another plant, merely on account of its five-lobed leaf. In this case we must seek for other characters, otherwise the beginner, who has seen nothing but the variety, will never come to the knowledge of the species.

§ 196.

The characters, by which all the species of a genus are distinguished, must be taken from one or a few parts.

In a genus which has many species, if I should characterize the first by the spike, the second by the leaves, the third by the stem, the fourth by the root, the fifth by the fruit, &c. no person with certainty would know the plants.

It is necessary to observe in the species of a genus, what parts afford the best characters, and if there are many, they must be pointed out, and the differences remarked, that there may be no uncertainty or mistake.

§ 197.

It is only at the time of flowering, or of ripening the fruit that characters should be taken.

No botanist can with certainty distinguish plants without flowers or fruit, otherwise he must by frequent practice have attained a facility in distinguishing them by their leaves. Thus characters afforded by plants before the developement of the flower or the ripening of the fruit are of no use.

§ 198.

The other characters by which species are ascertained must be learned by experience. It is further however to be remarked, that a description is to be made according to the rules of accurate terminology, in the following order; first the root, then the stem, the leaves, the fulcra, and lastly, the inflorescence. In a description, the colour of the flower is likewise to be mentioned, but superfluous or unimportant circumstances are to be omitted; such as that the root is under ground, that the leaves are green, &c. The old botanists frequently err in this respect.

§ 199.

The essential difference, or name, *(diagnosis)*, of the species is a short description containing only what is essential; according to the following rules.

The specific name must not be too long, and if possible should be contained in twelve words.

We have seen, (§ 196), that in forming the specific name we must express only the essential difference, and so characterise it, that he who sees the plant for the first time, though he has never seen the other species of the genus, may be at no loss to know what plant he has before him. Words that are superfluous, may be omitted, and only those made use of which distinguish the plant from all others. If more than twelve words are necessary for the complete denomination of the plant, they must be adopted: for it is better that the name be long and distinct, than short and unintelligible.

The specific name must be in the Latin language, and all the words in the ablative case.

We shall here recur to our old example, the Solanum *tuberosum;* the difference between which and the other numerous species of the genus is expressed as follows.

SOLANUM *tuberosum;* caule inermi herbaceo, foliis pinnatis integerrimis, pedunculis subdivisis.

In the specific name there must be no relative idea.

What was formerly said with regard to the distinguishing of the species is applicable here. Magnitude, colour, &c. are not to be made use of, because these things can only be understood by comparison with other plants, and we have not always at hand the object of comparison. The following, which errs against this rule, may serve as an example.

Solanum arborescens, tomentosum, latifolium; fructu magno cinereo. Barr. aequin. 104.

Who can know from this character what plant is meant?

There must be no negative expression in the specific name.

When in a specific name it is only said what the plant has not, it is evident that nothing certain can be learned from it; *e. g.*

Cuscuta caule parasitico, volubili, lupuliformi, aspero punctato, floribus racemosis, non conglomeratis aut pedunculatis. Krock Siles. 251.

When a genus consists of but one species, there is no occasion for a specific difference.

It is evident that a single species, that cannot be compared with another, can have no discriminating character. Thus it is, in particular, with Butomus, Paris, Parnassia, &c.

But when only one species of a genus is discovered, an accurate description must be made of it, that it may be distinguished if others should be discovered.

§ 200.

The complete description of the natural characters, (§ 151), of a genus, must be made in the following order; First, the calyx, then the corolla, the nectarium, the stamina, the pistillum, the fruit and the seed. In the compound flowers we end with the receptacle, and in the umbelliferae we begin with the involucrum. A full description of the genus is contained in the essential character, the rules for forming which have been already detailed.

§ 201.

Varieties, if they are not remarkable, deserve little attention from botanists: but if they are of a very singular figure, they must be taken notice of and described, that they may not be considered as species. Variations in colour only are of no consequence, being exceedingly subject to change, (§ 204).

§ 202.

In plants the following are the principal colours:

1. *Cyaneus*, dark blue, like Prussian blue.

2. *Coeruleus*, sky blue, like the flowers of Veronica *chamædrys*.

3. *Azureus*, azure blue, nearly the same with the former, but bright, like ultramarine.

4. *Caesius*, pale blue, verging towards grey.

5. *Atrovirens*, dark green, bordering on dark blue.

6. *Aeruginosus*, light bluish green, like verdigrease.

7. *Prasinus*, *saturate-virens*, *smaragdinus*, grass-green, without any tinge of yellow or blue.

8. *Flavo-virens*, green, verging upon yellow.

9. *Glaucus*, green, bordering upon grey.

10. *Aureus*, gold-yellow, without any foreign mixture.

11. *Ochraceus*, yellow, with a small tinge of brown.

12. *Pallide-flavens*, pale or whitish yellow.

13. *Sulphureus*, bright yellow, like the flowers of the Hieraceum *Pilosella*.

14. *Vitellinus*, yellow, with a slight tinge of red.

15. *Ferrugineus*, brown, verging towards yellow.

16. *Brunneus*, the darkest pure brown.

17. *Fuscus*, brown, running into grey.

18. *Badius*, *hepaticus*, chesnut or liver brown, bordering on dark red.

19. *Aurantiacus*, orange, or a mixture of yellow and red.

20. *Miniatus*, s. *cinnabarinus*, high red, like red-lead.

21. *Lateritius*, brick-colour, like the former, but duller, and verging towards yellow.

22. *Coccineus*, s. *phoeniceus*, cinnabar colour, with a slight tinge of blue.

23. *Carneus*, flesh-colour, something between white and red.

24. *Croceus*, saffron colour, dark orange.

25. *Puniceus*, fine bright red, like carmine.

26. *Sanguineus*, s. *purpureus*, pure red, but duller than the foregoing.

27. *Roseus*, rose colour, a pale blood red.

28. *Atropurpureus*, very dark red, almost approaching to black.

29, *Violaceus*, violet colour, a mixture of blue and red.

30. *Lilacinus*, lilac, the former colour, but duller, and verging more towards red.

31. *Ater*, the purest and deepest black.

32. *Niger*, black, with a tinge of grey.

33. *Cinereus*, ash-colour, blackish grey.

34, *Griseus*, lively light grey.

35. *Canus*, hoary, with more white than grey.

36. *Lividus*, dark grey, running into violet.

37. *Lacteus*. s. *candidus*, shining white.

38. *Albus*, dull white.

39. *Albidus*, dirty dull white.

40. *Hyalinus*, transparent like pure glass.

These colours are only used in describing the Lichens and Fungi: being not so variable in these plants as in others.

The colours are all represented on the 11th plate, for mere words do not convey a sufficient idea of them.

§ 203.

In general every part of a plant has a particular colour.

The root is for the most part black or white, sometimes brown, seldom yellow or red, but never green.

The stem and the leaves are commonly green seldom red, sometimes spotted with white or black, very seldom yellow, externally seldom blue, and only white or brown when covered with a tomentum.

The corolla is of every different colour, but seldom green, and still seldomer black: the calyx is generally green, seldom of any other colour, never black.

The filaments, are commonly transparent or white, seldom of other colours.

The succulent kinds of fruit are of all colours.

The capsules are brown, green or red, seldom black.

The seed is black or brown, seldom of other colours.

N. It is remarkable, that the yellow colour predominates in the compound flowers, and in most autumnal flowers. White is found chiefly in the spring flowers; white and blue principally in the flowers of cold regions; red and richly variegated colours in those of warm climates. White berries are commonly sweet; red, sour; blue, sweet and sour mixed; and black, insipid or poisonous.

§ 204.

Though the botanist seldom trusts much to colour; yet it is of use to know in what way flowers and fruits sometimes change from one colour to another.

In general most colours pass into white; the red and the blue are most prone to change. It is not often that the change is made into yellow, or that red passes into yellow; blue very often turns to red. We shall here give a few examples:

Red passes into white in

Erica, Serpyllum, Betonica, Pedicularis, Dianthus, Agrostemma, Trifolium, Orchis, Digitalis, Carduus, Serratula, Papaver, Fumaria, Geranium, and many others.

Blue changes into white in

Campanula, Pulmonaria, Anemone, Aquilegia, Viola, Vicia, Galega, Polygala, Symphytum, Borago, Hyssopus, Dracocephalum, Scabiosa, Jasione, Centaurea, and many others.

Yellow changes into white in

Melilotus, Agrimonia, Verbascum, Tulipa, Alcea, Centaurea, Chrysanthemum, &c.

Blue changes into red in

Aquilegia, Polygala, Anemone, Centaurea, Pulmonaria, &c.

Blue changes into yellow in

Commelina, Crocus, &c.

Red changes into yellow in

Mirabilis, Tulipa, Anthyllis, &c.

Red changes into blue in

Anagallis, &c.

White into red in

Oxalis, Datura, Pisum, Bellis.

Fruits, particularly the juicy kinds, often change their colours.

Black berries change into white in

Rubus, Myrtillus, Sambucus, &c.

Black into yellow in
Solanum.

Red passes into white in
Ribes, Rubus *Idaeus.*

Red into yellow in
Cornus.

Green into red in
Ribes *Grossularia.*

Black into green in
Sambucus.

The seeds of plants likewise frequently change from one colour to another; the poppy, *(Papaver)*, has both black and white seeds.

The seeds of papilionaceous flowers are most subject to vary in colour.

§ 205.

The leaves are in some plants naturally spotted; but the spots are not always constant; they frequently disappear altogether. Of this we have examples in the following:

Leaves with black spots.
Arum, Polygonum, Orchis, Hieracium, Hypochaeris.

Leaves with white spots.
Pulmonaria, Cyclamen.

Leaves with red spots.
Lactuca, Rumex, Beta, Amaranthus.

Leaves with yellow spots.
Amaranthus.

The leaves of some plants become red in autumn, as those of Rumex: others at times produce leaves wholly red, as Angelica, Fagus, Beta, Amaranthus. Most plants change into yellowish green, light green or dark green from excess of heat, or of cold, from defect in the structure of the vessels, or from variety of soil and situation. From similar circumstances, the margin or centre of a leaf is subject to change. Gardeners are fond of such plants, which they call *blotched.* When the margin is yellow, the leaves are called *folia aurata ;* when the centre has a yellow spot, they are called *folia aureo-variegata ;* when the leaf is white on the margin, it is called *folium argenteo,* s. *albo-marginatum ;* when it is white in the centre, it is called *folium albo,* s. *argenteo-variegatum.*

§ 206.

Besides in colour, leaves change also in number, breadth, figure and parts. In number leaves change only when they are compound or opposite. They vary often in breadth, so that an oval leaf, frequently becomes oblong, &c. Culture often changes the figure of leaves, especially in rich soils. Of this we have an example in the common colewort; and other plants acquire sometimes waved or crisped leaves.

The different divisions of leaves often change remarkably the appearance of a plant. The common elder, (Sambucus *nigra*), has sometimes finely cut leaves. The alder, (Betula *alnus*), has likewise lobed or divided leaves; and many others are subject to like varieties. Culture is the true touchstone of plants; by frequent sowing the seeds we can determine with certainty what are varieties, and what are species. This is the only means of arriving at the truth.

§ 207.

When the student has become acquainted with these rules, and by practice has attained a readiness in employing them, he will yet find difficulty in determining plants he has never seen before. In this case the following directions are to be observed:

In the first place he is accurately to examine the flower, and endeavour to refer it to its class and order, by attending to the number, proportion, and connexion of the parts of the fructification. When he has succeeded in this, he seeks out the genus in his system. Here, however, he may encounter some difficulties, which he must carefully endeavour to overcome.

The stamina, and likewise the pistillum, often vary according to the soil and climate in which the plant has grown, so that sometimes there is a stamen more or less than there should be: in this case he must examine many flowers, and be ruled by the majority. There is often likewise a luxuriance in plants, which doubles the number of parts; and often a defect, when a half is wanting: thus sometimes there are eight instead of four stamina, and sometimes only two. When in this case he cannot find the plant in the class where he thinks it ought to be, he must try the other classes where it may be. Sometimes the antherae and filaments are united, which is not the case in other species, and the sex also is subject to variation. Therefore when a plant is not found in the class to which it seems to belong, he must search the 21st, 22d and 23d classes. If he is convinced after these searches that the plant is new, he must describe it as such. Dr Roth and Professor Hedwig have done an essential service to botany by making an index of the most frequent variations in the number and sex of different plants.

When one has been fortunate enough to discover the genus of an unknown plant he must proceed to determine its species. He must compare the specific character, and never consider any plant as determined till he finds it agree with those laid down. When these characters are not sufficient, he then compares it with the synonyma, to see if from them he can discover it with certainty. In the references he makes to authors Linnaeus has, after the page, added an asterisk (*) to those who have given a good description of the plant, by which the further investigation is very much assisted. But when the plant is obscure, or not certainly known, he distinguishes it by a cross, (†).

The duration of a plant he has marked after the place in which it is a native. If it be a tree or a shrub, he marks it with this character, ♄; if a perennial with this, ♃; if a biennial thus, ♂; and if an annual thus, ⊙.

In the description of flowers, the following characters are used to mark the sex.

A hermaphrodite flower, *(flos hermaphroditus)*, ☿

A male flower, *(flos masculus)*, ♂.

A female flower, *(flos femineus)* ♀.

Male and female flowers upon one stem, *(flores monoici)* ♂—♀.

Male and female flowers on different stems, *(flores dioici)* ♂ : ♀.

Neuter flowers, *(flores neutri)* ♄.

Hermaphrodite and female flowers in one compound flower, *(flores hermaphroditi et feminei)*, as in the class Syngenesia ☿ | ♀.

Hermaphrodite and neuter flowers in one compound flower, *(flores hermaphroditi et neutri)*, in the same class, ☿ | ♄.

Hermaphrodite and male flowers on one stem, *(flores polygami)* ☿—♂.

Hermaphrodite and female flowers on one stem, *(flores polygami)* ☿—♀.

IV. NOMENCLATURE OF PLANTS.

§ 208.

It appears to be of little importance to give a plant a new name; but it is certainly agreeable to one who makes botany his study, to find a name that is appropriate, and easily and generally received. When the name is indeterminate and unsettled, the knowledge of the thing is lost. The old botanists were not much concerned about preserving the names of plants. Every one who turned author gave them new ones, and thus in those times the study of Botany was unpleasant and uncertain. Persons were disgusted with the barbarous, dry and unfixed nomenclature which prevailed, and declined entering on the study of the most beautiful objects of nature, on account of the difficulty and uncertainty which attended it. But by the introduction of fixed and generally received names, we are now able to make ourselves understood wherever Botany is known.

§ 209.

Tournefort, who undertook to reform the science of Botany, established genera, and invented names for them: but the species were still distinguished by short and often imperfect descriptions. The generic name was then, it is true, better defined, but the species were left still undetermined. In this, as in every other department of the science of Botany, Linnaeus has performed the most eminent service by establishing a generic name, *(nomen genericum)*, and a trivial name, *(nomen triviale)*, to every plant. The rule by which these names are imposed is as follows:

§ 210.

Each genus must be defined and properly denominated; and every new genus must likewise have a new name.

A name once properly imposed, is not afterwards to be changed. None but a botanist who is acquainted with the names of all other plants, has a right to impose a name, lest the same genus should receive two different names.

§ 211.

Generally received names must be preserved; and when new discovered plants receive two names from different botanists, the first that was imposed, if it is a good one, must be adopted.

As most botanists now follow Linnaeus, it is their duty to preserve his names when they are applied to true genera. In newly discovered plants, it often happens that two botanists, in different places, about the same time, give each a name to the genus. One only of these can belong to it, and therefore that which was first imposed, if it is good, and formed according to rule, must be received. For instance, the bread-fruit tree was described by Solander, by Forster and by Thunberg. Solander called it *Sitodium*, Forster *Artocarpus*, and Thunberg *Rademachera*. Forster's name was the first and likewise the best, consequently it is that which is generally received.

§ 212.

Names must not be too long.

If the name of a genus is composed of many short words, it becomes too long and displeasing to the ear. Some of the names given by the older botanists may serve as examples, *viz.*

Calophyllodendron.	Orbitochortus.
Cariotragematodendros.	Hypophyllocarpodendron.
Acrochordodendros.	Stachyarpogophora.
Leuconarcissolirion.	Myrobatindum.

§ 213.

Names must not be taken from foreign languages, nor even from the European; but, when it can be done, they should be formed from the Greek.

Names taken from foreign languages, even though they have a Latin termination, are improper, and cannot be so classically compounded as the Greek. Even names formed from the Latin are destitute of euphony, and still more so when they are compounded of Latin and Greek together. When it is possible they should be made out of two Greek words with a Latin termination. The following are examples of faulty names:

Out of the American languages.

Aberemoa.	Apeiba.	Apalatoa.
Bocoa.	Caraipa.	Cassipourea.
Conceveiba.	Caumarouna.	Faramea.
Guapira.	Heymassoli.	Icacorea.
Matayba.	Ocotea.	Pachira.
Paypyarola.	Quaypoya.	Saouari.
Tocoyena.	Voucapoua.	Vatoirea.

From the Malabar language.

Manjapumeram.	Balam-pulli.
Cudu-Pariti.	Cumbulu.

From the Latin language.

Corona solis.	Crista galli.	Dens leonis.
Tuberosa.	Graminifolia.	Odorata.

From the German language.

Bovista. Beccabunga. Brunella.

From other European languages.

Belladonna, Sarsaparilla, Galega, Orvala, Amberboi, Percepier, Crupina.

From Greek and Latin together.

*Lin*agrostis, *Cardam*indum, *Chrysanthem*indum, *Sap*indus.

Such names are always faulty; and though some of them have been recived, they ought never to be imitated.

The following names are better:

Glycirrhiza, from γλυκὺς sweet, and ῥίζα a root.

Liriodendron from λείριον a lily, and δένδρον a tree.
Ophioxylon — ὄφις a serpent, and ξύλον wood.
Cephalanthus — κεφαλὴ the head, and ἄνθος a flower.
Lithospermum — λίθος a stone, and σπέρμα seed.
Leontodon — λέων a lion, and ὀδὺς a tooth.
Hippuris — ἵππος a horse, and ὐρὰ a tail.

§ 214.

Plants must not be denominated by names already appropriated to animals or fossils.

The names of plants must not be the same with those of any animals or minerals; but each genus in all the three kingdoms of nature ought to have different names. The following are faulty in this respect.

Taxus, Onagra, Elephas, Ampelis, Natrix, Delphinium, Ephemerum, Eruca, Locusta, Phalangium, Staphylinus, Granatum, Hyacinthus, Plumbago.

§ 215.

Names must not be received that are borrowed from religious, divine, moral, anatomical, pathological, geographical, or other terms.

When we choose a name having a reference to religious or other matters, with which it cannot properly be compared, or which are not known to every one, it is good for nothing. The following names are therefore faulty.

Religious.

Pater noster.	Oculus Christi.
Morsus Diaboli.	Spina Christi.
Fuga Daemonum.	Palma Christi.

Calceus Mariae, Labrum Veneris,
Barba Jovis, Umbilicus Veneris.

Poetical.

Ambrosia. Cornucopia. Protea.
Narcissus. Adonis. Andromeda.
Gramen Parnassi, &c.

Moral.

Impatiens, Patientia, Concordia.

Anatomical.

Clitoris, Vulvaria, Priapus, Umbilicus.

Pathological.

Paralysis, Sphacelus, Veruca.

Oeconomical.

Candela, Ferrum equinum, Serra, Bursa pastoris.

From the native place.

Hortensia, China, Molucca, Ternatea.

§ 216.

The names of genera must be framed according to resemblances or properties, which, however, must be found not in one species of the genus only, but in several.

When the name can be formed according to the essential character of the genus, to the figure of the seed, its resemblance to other plants, or to the form of the flower, such a name is to be preferred, because it conveys some idea of the plant. The properties of a plant, or its colour, do not afford good names, though sometimes recourse must be had to them: but when the names are taken from unsteady marks, such as the woolliness of the leaf or stem, which is proper only to one species, they are to be rejected.

The following names are taken from a single part of a plant, and are not to be imitated.

Cyanella; on account of its blue flower; but there are species with white and yellow flowers.

Argophyllum; on account of its tomentose white leaves.

Gratiola; for its use in surgery.

Samolus; from the island of Samos, where it was first found.

§ 217.

Names ending in oides, astrum, astroides, ago, ella, ana, *must be carefully avoided.*

By these terminations the resemblances of plants to others are intended, at the same time implying a doubt. Those names of this kind are especially to be avoided, which are of a disagreeable or harsh sound; such as,

Alsinoides,	Lycoperdastrum,
Alsinella,	Lycoperdoides,
Alsinastrum,	Juncago,
Alsinastroides,	Erucago,
Alsinastriformis,	Portulacaria,
Anagalloides,	Breyniana,

Anagallastrum, Ruyschiana,
Clathroidastrum.

§ 218.

Names similar in sound must likewise be avoided.

A name may sometimes be very proper, but may be faulty in having nearly the same sound with another, and ought, therefore, to be changed, that it may not be mistaken in printing or speaking; such as,

Conocarpus,	Ambrosia,	Gaura,
Gonocarpus,	Ambrosinia,	Guarea.

§ 219.

The name of a class or order can never be received as the name of a genus.

The antients often use the name of a whole family for a single genus. This leads beginners into error, and one sometimes knows not whether a class or a genus is meant. Thus we find Lilium, Palma, Muscus, Filix, Fungus, &c.

§ 220.

The highest reward of a Botanist is to have a genus called after his name.

No monument of marble or brass is so lasting as this. It is the only way of perpetuating the memory of true botanists, or of those who have benefited the science.

The names of botanists must be preserved unchanged, only giving them a proper Latin termination; as, Linnaea, Royenia, Thunbergia, Sparmannia, Gleditschia, Halleria, Buxbaumia, Retzia, Smithia, &c.

If the name of the Botanist has a Latin termination, it must not remain so, but must end according to the rules of art. Hence, the following, as names of genera, are faulty, viz. Laguna, Senra, Milla, Cosmos, Acosta, Galinsoga:

They would be more scientific thus;

Lagunaea, Senraea, Millea, Cosmia, Acostaea, Galinsogaea.

It is likewise improper to introducethe praenomen of any Botanist into the generic name, as it is by this means made too long; e. g. Gomortega, from Gomez Ortega. Still less ought the names of two Botanists to compose the name of a genus; as Carludovica.

§ 221.

For the better distinguishing of the species, Linné, besides the generic name, contrived a second, which he called the trivial name, (*nomen triviale*, § 222). With regard to this the following things are to be observed.

§ 222.

A trivial name must be short, unlike to the generic name, and always an adjective.

Trivial names are intended as a help to the memory, and therefore if they are compound words they do not answer the end. It is likewise improper to annex to a generic name, which is always a substantive, another substantive. The following names are therefore faulty:

Carex Drymeja, Juncus Tenageja,
—— Chordorhiza, Scirpus Beothryon,
—— Heleonaster, Lichen Aipolius, &c.

The trivial name should always be an adjective, and should, if possible, signify some quality of the species; as, Carex paniculata, Carex canescens, Campanula patula, Campanula persicifolia, &c.

§ 223.

The figure, cloathing, and especially the specific difference, suggest the most appropriate trivial names.

When the specific difference can be expressed in one word, and that an adjective, such a trivial name always deserves the preference. But the adjective must not be too long, nor consist of two words. When such trivial name is not to be found, we must have recourse to the qualities, place of growth, and other circumstances.

§ 224.

The colour and native country afford very uncertain trivial names.

It cannot be known from the appearance of a plant whether it grows in this or in that country, nor whether another species may not likewise grow in the same place. Neither can it be known whether the colour of a plant is constant or not. Trivial names, from these circumstances, are not therefore to be recommended. Linnaeus has Polemonium *coeruleum*, though it varies with white flowers. Euonymus *europaeus* is not the only European species of that genus; the E. *verrucosus* and *latifolius* are both natives of Europe; and we might give other instances to shew that such names are not good.

§ 225.

The Botanist must attend to varieties when they are considerable; he must give them a second name, and mark them with a Greek letter, *e. g.* Brassica *oleracea.*

α. viridis,	ζ. selenisia,
β. rubra,	η. sabellica,
γ. capitata,	θ. botrytis,
δ. sabauda,	ι. napobrassica,
ε. laciniata,	κ. gongylodes.

In this way we can, in a few words, designate the genus, species and varieties of a plant, which the older botanists could not do without a long description.

§ 226.

The great advantage of the Linnaean names is not admitted by some botanists, and therefore they have attempted a change. First Ehrhart, considering that there are no proper genera in nature, but that these are invented by the ingenuity of botanists, proposes, in his Phytophylaceum, to denominate every plant by one word; thus,

Carex dioica he calls Polyglochin.
—— pulicaris —— Psyllophora.
—— arenaria —— Ammorrhiza.
—— capillaris —— Caricella.
—— pallescens —— Limonaetes.
—— humilis —— Baeochortus, &c.

By such names the science would be immeasurably burdened. There may be about 2000 known genera, and at an average 80,000 plants, which must all have their appropriate names. But what memory would be sufficient for such a nomenclature?

The idea of Wolff is of a very different nature. He proposes to distinguish every character of a plant, whether it be the figure of the flower, the stamina, style, fruit, leaves, root, stem, stipula, florescence, smell, colour, &c. by a particular letter, so that the name of every plant shall be composed of these letters, and thus shall convey an idea of its structure and properties. However ingenious such a proposal may be it is impossible to execute it. One may easily imagine what barbarous words would be formed by this method, and what a number of consonants might of necessity stand together, which no power of utterance could pronounce. To attain any facility in such a nomenclature would require a life-time, and the advantage, after all, would indeed be trifling.

§ 227.

As the trivial name of a plant is in most cases an adjective, it must begin with a small letter; as,

Rhus glabrum,	Lythrum virgatum,
Hieracium subaudum,	Euphorbia segetalis,
Dianthus chinensis,	Asclepias tuberosa, &c.

But when the trivial name has formerly been the generic name of the plant, it must then begin with a capital; as,

Rhus Cotinus,	Lythrum Salicaria,

Rhus Coriaria, Lythrum Hyssopifolia,
Dianthus Armeria, Asclepias Vincetoxicum.

The trivial name must always be written with a capital letter when it records the discoverer of the plant; as,

Hieracium Gmelini, Euphorbia Gerardiana,
Hieracium Kalmii, Erica Sebana, &c.

PHYSIOLOGY.

V. PHYSIOLOGY.

§ 228.

Besides the division into the three kingdoms of nature, (§ 2), natural bodies may be conveniently arranged into two great classes, viz. *organic* and *inorganic* bodies. *Inorganic* bodies are those, which are composed of heterogeneous particles, chemically or mechanically combined, and which, even when somewhat regular in their figure, are formed by external apposition. *Organic* bodies, on the contrary, are those, which are regularly composed of many differently formed organs, which, in the natural and healthy state, have the same structure with all the individuals of the same species. They grow larger in outward appearance by the action of an internal power, have a circulation of juices, and propagate their kind, so that they are continually reappearing in the same form that has been once prescribed to them. Under organic bodies are comprehended animals and plants.

§ 229.

The formation of organic bodies depends upon the diversity of matter and form. In every investigation, these are the last points which occur to us, until we resolve them into their first principles. Vital power or irritability is a property of organized bodies, which is connected with their composition and form; but we are still unable precisely to determine, whether it is merely the result of form and composition, or whether it constitutes an independent power: Experience, at least, in the vegetable world, seems to favour the former supposition. The elements, and the matter compounded from them, act upon organized bodies, and afford a stimulus, by which activity or excitation is produced. By the increase and continuance of the stimulus the irritability diminishes, and at last altogether subsides. Thus the same stimulus, that roused the irritable principle to action, promotes the decay of the organized body: consequently life is an exertion of vital power, by which a supply and combination of the matter belonging to the composition of the organized body, is constantly produced. By life, organized bodies are formed, increased, and supported, and by it the parts which have been injured by accident are restored. The faculty of assimilation, of the power of locomotion, and of reproduction, are therefore only consequences of life; just as elasticity and contractility are properties of matter alone. Combinations of matter in organized bodies, in consequence of the irritable principle, are regulated by other laws than those of chemical affinity; and when the vital power ceases, they are destroyed; *i. e.* when the vital power ceases, the matter, of which organic bodies are composed, is combined according to the laws to which inorganic bodies are subject.

§ 230.

Elasticity, *(elasticitas)*, which is peculiar to the matter of organized bodies, appears both in the living and decayed state of vegetables. It is perceptible in the ligneous fibre, in resins, and other parts and productions of plants. Contractility, *(contractilitas* s. *vis mortua)*, is chiefly peculiar to wood. In economical use the expansion and contraction of wood are very troublesome properties, which can be destroyed only by a particular mode of treatment. The dry stalks of Anastatica *Hierochuntica*, commonly called the rose of Jericho, the seed-vessels of the genus Mesembryanthemum, many species of which are known to gardeners by the name of the Candian flower, the dry calyx of Carlina *vulgaris*, are in this respect the same as wood. They expand in wet weather, and contract when dry.

The same observation applies to liverworts and mosses, which during summer appear to be withered, but in cool, moist weather, and in autumn, again begin to grow and expand.

The contractility of ligneous fibres fits them for being Hygrometers. Formerly it was thought that plants could grow in breadth, only by the expansion of the interstices between the fibres of the wood, when moisture pervades them. Mr De Luc, however, has shown, that the fibres themselves may be elongated, though in a small degree, and may again contract. And he has made the singular remark, that box-wood contracts its fibres longitudinally when moist, but elongates them in a dry atmosphere. It however undergoes the changes in breadth in the same manner as other wood. He examined a great number of different sorts of wood; but not one showed the phenomenon of box-wood. That vegetables as organized bodies are possessed also of vital powers, admits of no doubt, as is sufficiently demonstrated by their growth, formation, and decay. On a few different parts only the operation of the applied stimulus becomes visible.

The leaves of Mimosa *pudica*, *sensitiva*, *casta*, of Oxalis *sensitiva*, Dionaea *muscipula*, and other plants which grow only within the tropics and under the equator, contract when touched. Less conspicuous, but easily demonstrable, is the contractility in the indigenous species of sun-dew, Drosera *rotundifolia* and *longifolia*. The filaments of Urtica, Parietaria, Berberis, and others show great irritability, and likewise the pistils of some plants, especially the stigma of Martynia. According to some experiments, light acts as a particular stimulus upon plants.

Vegetables appear to be little susceptible of the power of Galvanism. The result of the experiments hitherto made, is so very dubious that we cannot venture to advance any opinion upon this subject.

Electricity acts powerfully upon plants as well as upon animals, and the effects which it produces in both are exactly the same: viz. Electricity, when faintly applied, is beneficial to their growth, but becomes hurtful to them when exerted with any degree of violence. Van Marum destroyed plants by violent electric shocks, and I myself made a similar experiment on the Drosera *rotundifolia*. This plant remained quite uninjured in the electrical bath, but when I began to extract sparks from its leaves, it soon withered away.

The power of reproduction, which is one of the consequences of life, is common to animals and plants. It is less perceptible in plants than in animals and worms.

Slight wounds in the cortex heal very easily, and Duhamel, after he had, with the greatest care, completely removed the bark of a tree, observed it again beginning to appear. With regard to plants of many stamina, it has been alledged by some, that, immediately after the removal of the stamina, similar bodies, though void of pollen, are reproduced. But this is not properly reproduction, because the parts thus procreated are not of the same structure as formerly.

The leaf of a plant, which has been at all mutilated, will never be renewed, neither will the leaves of flowers, which have been injured, either in a perfect or an imperfect state, ever be fully reproduced. If we divest a willow, or any other tree of its branches, and the tree produce new ones, we cannot look upon this as a reproduction, because the tree is a compound plant, (§ 232), and every branch, or rather every bud, can be considered only as a particular plant. Thus, then, the growth of the pruned branches is a production, but not a reproduction, for in the greater part of leaf-bearing wood, the whole surface is capable of producing buds and branches.

§ 231.

Philosophers have constantly endeavoured to discover resemblances between animals and plants. Aristotle called vegetables reversed animals. Linnaeus pursued this idea still farther, but his lively imagination carried him too far, when he denominated heat, the heart, and earth, the stomach of plants, and even when he, with more justice, compared the leaves of plants to the lungs of animals. Comparisons of this kind must always fail, as animals and plants differ very materially in the form of the organs of which they are composed.

But the most successful on this head was the immortal Bonnet, who, in a very ingenious manner, has compared the egg, the embryo, the nourishment, and the generative organs of animals to those of vegetables.

§ 232.

This likeness which philosophers observed between animals and plants, chiefly consisted in properties, which organized bodies possess without respect to their structure. It is, therefore, certainly worth while, to consider more accurately, in what respects plants differ from animals.

Animals take food by a certain aperture, and have a particular canal by which they propel their excrementitious matter.

Plants, on the other hand, take in nourishment with their whole surface, and except transpiration, which they possess in common with animals, have no peculiar canal to expel their excrements, unless we consider the drops which are found on the roots of some luxuriant plants, as a proof of the contrary. Of this more shall be said hereafter.

Plants have a structure altogether different from that of animals. They consist of variously combined vessels, which are surrounded by a cellular membrane. The existence of muscles in plants has not yet been clearly evinced, nor have nerves hitherto been perceived in them. The wood, which some have compared to bones, has certainly not the least resemblance to them.

Plants consist of a cuticle, *(epidermis* s. *cutis)*, (fig. 279, 280, 281), which appears in woody plants to be converted into the outer bark, *(cortex)*. It covers the inner bark, *(liber)*, which is solely composed of vessels. This is followed by the *alburnum*, or the soft wood, as it is called. The wood, *(lignum)*, is inclosed by the last, and surrounds the pith, *(medulla)*.

The inner bark, alburnum, and wood, are one and the same substance at different periods of grotwh. The innerbark is converted into alburnum, and this into wood. They are all three compressed vessels, which are more or less hard, or still soft.

The pith almost entirely disappears in very thick large trunks, by the increasing solidity of the wood, and only in a few plants remains uniformly throughout all parts of the trunk. We find it in herbaceous plants, but most aquatic plants want it entirely.

The stems of herbaceous plants have neither alburnum nor wood. The epidermis, which rarely in them is converted into bark, incloses a ring of vessels, corresponding with what in woody plants is called the inner bark. Immediately beneath this we have a more or less dense cellular membrane, *(tela cellulosa)*, which is often very succulent, and next to it, a fleshy substance, *(parenchyma)*. This incloses the pith, which in fact is a cellular texture of a different nature, at times dry or juicy, at other times consisting of close and narrow cells.

Animals, with the exception of some of the vermes, are simple beings, but most plants not so; for only some annuals and palms are simple plants, the rest are all of a compound structure. If we put the seeds of an annual plant, (§ 125, No. 8, α.), in the ground, plants grow from it, which soon flower, produce seeds, and then die. The buds of trees and shrubs are to be considered as annual plants, for as soon as they have blossomed and shed their seeds, they entirely decay. The trunks of trees and shrubs as well as the roots of perennial plants have a great many buds, which are all of the same nature, and may be considered as repositories of many other annual plants. They are, therefore, not simple, but like the polypes in the animal kingdom, compound bodies. Below the bark in these plants there are, according to the species, as we shall more particularly specify, the rudiments of a number of buds, which by due supply of sap, may be finally evolved. New-formed branches of clipped willows, are therefore not to be considered (§ 216), as reproduced parts.

§ 233.

We learn from chemical analysis that the constituent parts of vegetables are very different from those of animals. Carbon, hydrogen and oxygen are the simple substances of which plants are principally composed. Azote is perceptible in all the parts of animals, excepting in the fat. It is found in few plants, and that only in particular parts. Carbon is the chief constituent of vegetables. It is from this that plants in dry distillation emit so great a quantity of carbonic acid gas, and leave behind them many pieces of coal.

Sulphur and phosphorus, both of which abound in animals, are but rarely observed in the vegetable world. Sulphur becomes perceptible in the roots of the Rumex *Patientia*, after they have been rubbed and immersed in water.

Sulphur and phosphorus are both visible in plants of the fifteenth class, (Tetradymania) which also contain azote. They are found also in the seeds of the different species of grain.

The seeds of Sinapis *alba*, and Triticum *aestivum*, when distilled, emit phosphorus, and the ashes of all plants of the Tetradynamia class contain phosphate of lime.

Potash or vegetable alkali exists in almost all plants, though in very small proportions. The Filices, the Erigeron *canadense*, the fruits of the Syringa *vulgaris* and Aesculus *Hippocastanum* are alone particularly supplied with it. It is found most frequently in combination with vegetable acids.

Soda is peculiar to marine plants.

Lime is a residuum found in the ashes of plants, and was formerly combined with vegetable acids. It is most plentiful in the Chara *tomentosa*, a pound of which yields six ounces of carbonate of lime. In the Fungi, at least in the Peziza and Byssus, not a particle of lime can be discovered.

Alumina, Silica, and Magnesia are not nearly so general. The first occurs very seldom. Silica exists in the ashes of most vegetables, but is found chiefly in the grasses.

In the Bambusa *arundinacea*, it produces a peculiar concretion. It also forms a consituent part of the fibres of plants. It appears to exist in the wood of the Alnus *glutinosa* and Betula *alba*, as the wood when turned upon the lathe frequently appears to glitter. Magnesia is much less frequent than lime. Some plants, however, possess it in as great a degree. Thus, the Salsola *Soda* has in one pound nearly five drachms of pure magnesia.

Barytes is alleged by some to exist in the grasses. Iron, but still more frequently, manganese is perceptible in the ashes of almost every plant*.

The following salts, compounded from neutrals, are the most abundant in the vegetable kingdom. Sulphate and Muriate of Potash, Sulphate of Lime. Sulphate of Soda is not so common. It is found in

* The gold, which chemists have discovered in the Vitis *vinifera*, Quercus *Robur*, Carpinus *Betulus*, and Hedera *Helix*, must have originally been introduced by the lead employed in their process.

the Tamarix *gallica*. Muriate of Soda exists in several marine plants, and is found in a crystalized form on the leaves of a South American plant. Nitrate of Potash is seen in the Borrago *officinalis*, Helianthus *annuus*, Mesembryanthemum *crystallinum* and *edule*, Achillea *millefolium*, Fumaria *officinalis*, Sonchus *arvensis*, &c. &c. Nitrate of Magnesia in Zea *Mays*.

§ 234.

From the chemical principles now premised various substances are formed, according to the diversity of proportion, and the particular kind of combination. These are called the more immediate constituents of vegetables. The following are all that have hitherto been discovered:

1. Mucilage, a tasteless, friable substance, destitute of smell, and soluble in cold or warm water, to which it communicates a viscidity. It is found in almost all plants, and in some forms the constituent part; for example, in the roots of the Althaea *officinalis*, in the stalks of the Astragalus *creticus* and *gummifer*, in the leaves of the Malva *rotundifolia*, in the seeds of the Pyrus *Cydonia* and Plantago *Cynops*, in the flowers of the Verbascum *Thapsus*, &c. It exudes from the bark of some trees like gum; for example, Mimosa *nilotica*, Prunus *domestica* and *avium*.

2. Sugar possesses a peculiarly sweet taste, dissolves in cold or warm water, and in spirit of wine. It is found in a great many plants, but seldom pure, as it is generally combined with Mucilage, extractive, acids, or Neutrals which have an excess of acid,

Neutral salts. Pure sugar is obtained from Saccharum *officinarum*, Acer *saccharinum* and *dasycarpum*. A mixture of Honey and Manna differ very little from sugar.

3. Vegetable acids consist of carbon, hydrogen, and oxygen, and their diversity originates in the variable proportion of these constituents. We are at present acquainted with six kinds of vegetable acids, namely:

a. Tartaric acid is found as supertartrate of potash in the fruits of the Vitis *vinifera*, Tamarindus *indica*, Berberis *vulgaris*, and Rhus *typhinum*, in the herb of Melissa *officinalis*, and Centaurea *benedicta*, in the roots of the Ononis, &c.

b. Oxalic acid, which like the former, is frequently combined with potash, occurs as superoxalate of potash in different species of the Oxalis and Rumex. It is found perfectly neutralized in a great many barks and roots, and in this state is particularly plentiful in Rhubarb.

c. Citric acid is discovered combined with a little mucilage, in the fruits of Citrus *medica*, Vaccinium *Oxycoccus*, *Vitis idaea*, and Prunus *Padus*. It is found almost equally mixed with mucilage and malic acid, in Ribes *Grossularia*, Rubus *Idaeus*, Ribes *rubrum*, Vaccinium *Myrtillus*, Pyrus *Aria*, Prunus *Cerasus*, Fragaria *vesca*, &c.

d. Malic acid differs from the preceding in this respect, that it never appears in a crystalized form. It is found as pure acid, and never combined with potash. It is contained almost pure, at least combined only with sugar and mucilage, in sour apples, in the fruits of the Sambucus *nigra*, Prunus *spinosa*, Sorbus *aucuparia*, and Prunus *domestica*. The juice of several species of Sedum, Sempervivum, Crassula, and Mesembryanthemum, contains a great quantity of Supermalate of lime.

e. Benzoic acid may be sublimed without being destroyed. It is discovered in the resin of the Styrax *Benzoin*, in the balsam of the Myroxylon *peruiferum*, and Toluifera *Balsamum*, and last of all in the fruit of the Vanilla *aromatica*.

f. Gallic acid possesses the property of precipitating iron black, and is found combined with tannin in all plants of an astringent taste.

4. Starch does not combine with cold water, but, combines with boiling water, and forms a well-known paste. It is a constituent of the different species of corn, of bulbous roots, and others; such as, Orchis, Arum, Jatropha *Manihot*, Solanum *tuberosum*, Bryonia *alba* and *dioica*, Poeonia *officinalis*, &c. The pulp of some palms is pure starch, for example, the well-known Sago of Caryota *urens*. It is found in the seeds of some plants, as in Aesculus *Hippocastanum*, Amygdalus *communis*, Lichen *islandicus*, *rangiferinus*, *&c.* and in many liverworts,

5. Gluten seldom occurs in the vegetable kingdom. It does not dissolve in water of any temperature. Before being dried it is very viscous, tenacious, and elastic; when dried, it resembles horn, and burns with precisely the same smell. Upon the whole, as it contains azote, it approaches nearer to animal substances. It is separated from the flour of wheat by washing in cold water. It is found also in the juices of beech and birch trees, and in the woody fibres of several plants*.

6. Albumen dissolves only in cold water. It is hardened by boiling water, and, when distilled, sets loose volatile alkaline salt. It is found in the farinaceous seeds of several plants, in those of the Tetradynamia class, in the juice of white cabbage, in the root of the Scilla *maritima, &c.*

7. The extractive principle, when separated from other constituents with which it is combined in the plants, is a solid bitter rough-tasted substance, which may be dissolved at any temperature in water or spirit of wine. It discovers itself chiefly by its great affinity for oxygen, which it rapidly absorbs, thus becoming insoluble in water. It is found in almost every plant without exception, never pure, but combined with mucilage, sugar, resin, acids, &c. &c. In modern times only it has been properly distinguished. Formerly it was confounded with vegetable mucilage, or, when by being combined with oxygen

* Ammoniacum or volatile alkaline salt, is, in chemical analysis, originally formed from azote and hydrogen in the plant, and is seldom to be found on them in such a state.

it had become insoluble in water, it was considered as resin. The name soapy matter, which is sometimes given to this substance, is improper, and often leads to very erroneous ideas.

8. Tannin is a solid friable brown substance of very astringent taste, and has some resemblance to the extractive principle, but differs in this respect, that it transforms animal jelly into a viscid substance insoluble in water and proof against corruption. On this is founded a property which plants, containing this matter, possess of converting the gelatinous skin of animals into insoluble leather. Tannin also precipitates in various colours the metals which have been dissolved in acids. It precipitates iron, black, by which means common ink is obtained. It is always found combined with gallic acid in the barks of many trees, in many kinds of wood and roots, in the leaves of some plants, and in the excrescences occasioned by insects.

It abounds chiefly in Quercus *Robur* and *pedunculata*, Rhus *typhinum*, in the bark of Salix, Alnus, Fraxinus, and Cinchona, in the nut-shell of the Juglans *regia*, in the roots of Tormentilla, Potentilla, Fragaria, Polygonum *Bistorta*, &c. &c.

9. Fixed oil is an inflammable, tasteless fluid without smell, and is not soluble either in water or in spirit of wine. Combined with caustic alkaline salt it becomes soap which is soluble in water: it is destroyed by the heat of boiling water. It consists principally of hydrogen and carbon, and is found almost exclusively in the seeds and fruits of vegetables; for example, Amygdalus *communis*, Linum *usitatis-*

simum, &c. &c. Cyperus *esculentus* is the only plant hitherto discovered, the root of which yields fixed oil.

10. Wax is a vegetable oil condensed by oxygen, and is discovered in the fruits of Laurus *nobilis*, Myrica *cerifera*, Tomex *sebifera*, and in the pollen of almost all plants. It is from this that bees prepare their wax.

11. Resin is a brittle, solid substance, which, though insoluble in water, may be dissolved in oil and spirit of wine. It is melted with slight heat, and burns with the application of flame. It is found in a great many plants, as in the Pinus, Juniperus, &c. combined with real volatile oil, it is called balsam. Some allege that the name balsam should be given only to such resins as contain benzoic acid.

12. Caoutchouc is a very elastic substance, not unlike leather, and is soluble only in Ether. It proceeds like milky juice from the trees in the torrid zone, for ex. Suphonia *Cahuchu*, Commiphora *Madagascariensis*, &c. It is found in the berries of Viscum *album*. It is probably a constituent of several gum-resins.

13. Gum-resins, Mucus-resins are to be considered not as mere mixtures of Mucus or gum and resin, but as possessing a compound nature, and as properly forming the more immediate constituents of vegetables. They flow like milk from several plants. Some approach to the nature of oxidized extractive. They also contain resin, sugar, mucus, Caoutchouc, and volatile oil. Several species of gum used by

apothecaries belong to this class, for ex. Assafoetida, Sagapoenum Ammoniacum, Galbanum, &c. &c.

14. Volatile oil is an inflammable volatile liquid which wholly dissolves in spirit of wine, and partially in water. It has a remarkable taste and smell, and may be distilled over without being destroyed. It is found in a great number of plants, and may be contained in all their parts,* roots, wood, rinds, leaves, flowers, fruits, principally, however, in the *pulp* of fruits. Although volatile oils all agree with one another in their essential qualities, they differ considerably in regard to colour, smell, taste, consistence, and weight. In progress of time they condense, and assume the appearance of resins, by being combined with oxygen.

15. Camphor is a solid white-coloured substance, friable, and very inflammable. It has a peculiar smell and taste, and is extremely volatile. It exists chiefly in all the parts of the Laurus, *Camphora*, as also in many species of Laurus *Cinnamomum*, &c. Some volatile oils also contain it, for ex. those of Lavandula *Spica*, Origanum *Majorana*, Salvia *officinalis*, *&c*.

16. The bitter principle is found in those plants which in a fresh condition burn the mouth and blister the skin, but which lose this property when dried; for ex. Scilla *maritima*, Arum *maculatum*, Helleborus *niger*, Chelidonum *majus*, Digitalis *purpurea*, most of the species of Ranunculus, &c. &c. It is sometimes combined with volatile oils; for ex. Cochlearia *armoracia*, *officinalis*, Sinapis *alba*, *nigra*, *&c*.

17. The narcotic principle, is considered as the original cause of the bad effects which the fruit of several plants produces on the brain, in diminishing the power of sensation and motion, and, when taken in large doses, by inducing sleep, and in the end occasioning vertigo, stupefaction, and even death. To this description belong Papaver *somniferum*, Hyoscyamus *niger*, Datura *Stramonium*, Prunus *Laurocerasus*, Atropa *Belladonna**, *&c.*

18. Fibrin must necessarily be considered as a proper constituent of vegetables, as its chemical process in plants is different from what it is in all other bodies. It is quite insoluble, has neither taste nor smell, and, beside the three necessary elements, also contains azote †.

§ 235.

As the life of animals depends on external warmth, so likewise plants need a certain degree of it. Plants of warm countries require more of it than those which belong to cold ones. These are facts which

* These two last substances have not yet been sufficiently investigated and ascertained.

† Some rank a particular colouring principle among vegetable substances; but the property which some plants possess of communicating a certain colour to matter, is common to several constituents of vegetables. It is often pure extractive, but more frequently combined with oxygen, sometimes too the colouring constituents are of a resinous nature. Several well-known colours, as Indigo, woad, litmus, &c. are not constituents of the vegetables from which they are procured, but in reality productions of art.

need no further demonstration. But whether plants, like animals, have a fixed and peculiar degree of heat, is a question which must now be answered. We find that trees or shrubs, in cold climates, if they grow wild, endure the greatest cold without harm. As soon as the warmth of spring commences, they evolve their buds, and apparently suffer no bad effects from the cold, though their stem and branches are full of moisture. If in a strong frost we put vessels with water close to such a tree, we shall find that the water is converted into ice, but that the tree retains its sap unfrozen, and remains quite unhurt. The case is different in plants of warm and hot regions. The sap of these plants congeals at the least degree of cold, and the plants decay. Thus there appears a remarkable difference between the plants of cold and those of hot climates. As long as plants live and possess sufficient vital power to resist cold, their sap will not congeal. But after the buds have been forced out by the warm weather of spring, they will, when exposed to cold evenings, be observed to congeal. We find, likewise, that dead or diseased branches are more liable to be frost-bitten than living and sound ones, and that branches, by their sap being congealed, are destroyed. The birch and some other plants, it is well known, often have their roots covered with ice, without suffering the least injury. In the northern hemisphere of our globe there are many and extensive tracts of pine trees, which resist with their evergreen branches the most severe winter cold. From those observations it follows, that each plant, according to its species, possesses a peculiar degree of warmth, which defends it against the inclemency of the weather.

But this heat in vegetables is not of such a nature as to enable us to judge of its peculiar degree by our senses. We know that every animal has a certain degree of heat. We find a frog or lizard cold, although nature has given them a certain degree of heat. The temperature of plants is such as to enable them to resist both heat and cold. If, in a hot summer day, we touch some ground which is much exposed to the rays of the sun, and immediately after put our hand on green grass, equally exposed to them, we shall find the ground much hotter than the grass. Fruits, though much in the sun, will be cool, whereas a glass full of water will be quite warm in a much shorter time.

Sonnerat discovered in the island of Lucon a rivulet, the water of which was so hot, that a thermometer immersed in it, rose to 174° Fahrenh. Swallows when flying seven feet high over it, dropped down motionless. Notwithstanding this heat he observed on its banks two species of Aspalathus and the Vitex *Agnus castus*, which with their roots swept the water. In the island of Tanna, Messrs. Forsters found the ground near a volcano as hot as 210° Fahrenheit, and at the same time covered with flowers.

Hence it naturally follows, that plants, like animals, have a peculiar temperature, according to their native countries, which they cannot exceed without injury. The experiments of Mr J. Hunter and Schoepf shew us the same thing. The first put a

Scotch fir, three years old, in a freezing mixture of between 15° and 17° Fahrenheit. The youngest shoot froze; the fir was again planted, the young shoot remained flaccid, but the first and second were fresh. Of young plants of oats, which had only three leaves, one leaf was exposed to artificial cold at 22°, and was instantly frozen. The root was put into the same cold mixture, but remained uninjured. He then planted it, and all its parts grew, except the leaf, which had been frozen. The same experiment he repeated in a young bean; a leaf of it was frozen in an artificial freezing mixture, and another fresh lea' was bent in the middle upon itself, put into a leaden vessel, and along with it the frozen leaf, which had been previously thawed. He afterwards put the vessel into a freezing mixture. The surface of the fresh leaf froze as far as it came in contact with the vessel between 15 and 17°, the atmosphere being at 22°. The frozen leaf froze much sooner. These experiments were repeated, and attended with the same result. The juice of spinnage and cabbage, when squeezed out, congealed at 29°, and thawed again between 29—30°. This juice was frozen in a leaden vessel and then put into another, with a cold mixture at 28°. The leaves of a growing fir-shoot, and a bean-leaf were put upon the frozen liquid which in that place thawed in a few minutes. The leaves had the same effect when removed to other frozen spots.

Schoepf made the following experiments in North America. He bored holes in different stems, which he again closed up. In one of the holes he put a thermometer in cold weather, in order to compare the internal heat with that of the atmosphere. The result, however, differed at different times, and in proportion to the different thickness of the stem. He made some other experiments by means of a thermometer, comparing the temperature of the atmosphere with that of the leaves. The above related experiments of Mr Hunter plainly shew, that the juices of plants have a peculiar temperature of their own. But those of Schoepf cannot, as he himself acknowledges, serve as decisive proofs, because the ligneous stems of plants possess a less degree of vital power, and the inner bark only (as will afterwards be demonstrated, § 297), is in every tree or shrub the seat of this power. The power of conducting caloric, which certainly in wood is not so strong as in other bodies, alone, produces a change of temperature, and renders the experiments of Mr Schoepf very uncertain *.

§ 236.

The anatomical investigation of vegetables explains the nature of their internal parts. The fol-

* Grass, roots, and the pine tribe, and all plants in general which have a more tenacious sap, can resist cold better than others. But trees which lose their leaves, are, as long as the leaves remain, very susceptible of its impression. The reason seems to be, that all sap, as long as the stem has its leaves, circulates very quickly, and being thinner, is more liable to suffer by cold. We find, in early winters, that those trees which lose their leaves, sustain no injury.

lowing organs have been discovered in them; air-vessels *(vasa pneumatophora)*, adducent vessels *(vasa adducentia)*, reducent vessels, *(vasa reducentia)*, lymphatic vessels, *(vasa lymphatica)*, cellular texture, *(contextus cellulosus)*, vegetable fibre *(fibra vegetabilis,)* and glands, *glandulae.*

These parts are visible only through magnifying glasses, either by subjecting them to maceration, or by putting them in newly cut pieces under a microscope. Some of them, particularly the adducent vessels, may be filled with a strong coloured liquid, by which means they are so much the more easily observed. This, however, is the case only with a few. The injection of vessels with a coloured liquid is accomplished by putting the stalk of a plant into a decoction of brasil wood, and placing it in a warm temperature. Injections of this kind do not succeed with all plants, but are particularly suitable to the Impatiens *Balsamina.*

§ 237.

The air-vessels *(vasa pneumatophora)*, are thin, hollow, corrugated vessels, smooth within, and running perpendicularly through the plants. They are conductors of air, and never change their diameter, but uniformly remain open even in the hardest wood. How they are connected with the pores of the epidermis, has not yet been discovered by any observations.

§ 238.

The adducent vessels, *(vasa adducentia)*, are situated close to the air vessels, and have a double direction. They either proceed in a straight line with the air vessels, or they twine around them in wide or narrow interstices, but they are often involved in spiral windings, so close that no interstice can be perceived. When they have this twisted appearance, they are called spiral vessels, *(vasa spiralia, pneumato-chymifera, fistulae spirales)*. In plants we discover twisted vessels of greater or less extent, as well as those which run straight out in lines. There are also vegetables in which they are never twisted, but uniformly proceed in straight lines, for example, Sagittaria *sagittifolia*, and all the Filices.

It is a singular circumstance, that in the Filices, bundles of these last mentioned vessels are surrounded with a peculiar sort of membrane which is quite abstracted from the cellular texture, a section of which shows it to be more or less circular, lunated, or of a different form.

These vessels are much more delicate than air vessels in their diameter, and even do not retain the same figure. They visibly grow larger, become rough, and when beginning to harden, have their interior covered with contiguous fibres; in the end they are almost completely obstructed.

§ 239.

Reducent vessels *(vasa reducentia)*, descend between the cellular texture, and are variously accumulated. Sometimes they take a horizontal direction. Hedwig supposes them to be intended for the purpose of transpiration. They are more delicate than the adducent vessels.

§ 240.

Lymphatic vessels *(vasa lymphatica)*, are found upon the epidermis (§ 232). They are extremely delicate, run singly, and are reticularly united. The circle or quadrate which is described on these vessels, has usually in its centre an aperture, which, however, has no connexion with the vessels, as will be shown in the sequel. The reticular form varies greatly in vegetables. It is constantly found in every species, and in a few, is subject to some alterations. Thus, for example, in the Lilium *chalcedonicum*, these vessels run in an undulating manner, and describe very irregular oblong figures or even rhombi, (fig. 279;) in the Allium *Cepa* they do not undulate, but proceed in an oblique direction parallel to one another by short continuations of the sides (fig. 280), in the Dianthus *Caryophyllus* they describe parallelograms which terminate pretty regularly. This reticular texture covers all the parts of plants, only the apertures which it surrounds are not always obvious. On the root, on the surface of the leaves, on the interior side of the valves of the calyx, especially when they are coloured, on the interior of the petals, on the nectaria, in stamina and pistils no pores can be discovered, and only the cicatrice has them sometimes. That this kind of net on the cortex of vegetables is not occasioned by the pressure of the cellular texture, but consists of real vessels, appears to be beyond all doubt.

§ 241.

The cellular texture *(contextus cellulosus, tela cellulosa* s. *utriculi)*, is a very delicate membrane, divided into an infinite number of variously formed small spaces, which are closely connected with one another. It surrounds the vessels, and occupies the internal as well as the external interstices, covers both surfaces of leaves, and is most plentiful in the juicy plants and fruits. When the cellular texture is very dense and succulent, it is called, especially in flesh *(parenchyma,* s. *pars carnosa,* § 232*)*. The pith of vegetables (232), is a more dense cellular texture, distinguished by its bright white colour, by its finer and more compressed cells, and by its spungy appearance.

The juices conveyed in the cellular texture vary according to the different species. They are,

Resinous, in many species of fir, &c.

Gummy, in fruit-trees and some species of Mimosa.

Lymphatic, in almost all plants.

The colour of the juices found in the cellular texture, is also very multifarious.

The sap likewise varies in colour: It is

White, in Euphorbia, Papaver, Leontodon, Pinus, &c.

Yellow, in Chelidonium.

Red, in Rumex *sanguineus*, Dracaena *Draco*, Pterocarpus *santalinus*, Calamus *Rotang*.

Blue, in the root of Pimpinella *nigra*.
Green, in some umbellatae.
Colourless in most plants.

The juices in fruits are known to be of all colours. Rafn discovered a great analogy between the sap of plants and the blood of animals. He detected, with a microscope magnifying 135 times, in the lymph of Euphorbia *palustris*, round globules, like those in blood, swimming in a fluid somewhat more clear, but not so clear as water. Fontana observed the same in the sap of the Rhus *toxicodendron*. Rafn, however, found in the Euphorbia, besides the globules, prisms, which appear in Euphorbia *peplus*, *helioscopia*, *esula*, *cyparissias*, and *lathyris*, though somewhat different. In no plant but the Euphorbia and Hura *crepitans* could he detect the prisms. One drop of lymph of Euphorbia *canariensis*, *Caput Medusae*, Chara *neriifolia* had one or two prisms at most. Alcohol congealed the juice of the Euphorbia and formed a great deal of fibrous matter. Vitriol also converted it into fibres, which however were not so thick. The sap of Chelidonium consisted of nothing but closely cohering globules. In the colourless vegetable juices, even in them which are seemingly moist, the same globules appeared. A proof that the sap of some vegetables, for instance, the Potentilla *anserina*, is not, as Plenk supposes, merely impure or unfinished water. Rafn found in those plants which have much cellular texture, *e. g.* the Musa *paradisiaca*, Strelitzia *Regina*, the globules smaller and less frequent than in the species of Euphorbia.

The apertures which are discovered between the lymphatic vessels (§ 240) on the epidermis of plants are connected with the cellular texture, and by the operation of the rays of light may be opened and shut, and, according to Hedwig, are designed for transpiration. Secondary vessels, *(vasa secundaria)*, which Schrank has amply described, are hairy or bristly formed elongations of the epidermis, of a complicated nature, hollow within, and are connected too with the cellular texture. Some suppose that that they are created for the purpose of suction *.

§ 242.

The vegetable fibre, *(fibra vegetabilis)*, is a thin filiform body, found in bundles, and has apparently no cavity within; it is encircled with the cellular texture, which forms around it a particular kind of sheath. That this single fibre of vegetables may consist of several, will not be disputed; but to resolve it into its individual parts, and to demonstrate the most simple fibre, will probably continue to baffle our researches.

Rafn is much inclined to consider the vegetable fibre as a particular and original organ, similar to the muscular fibre of animals. Hedwig, on the contrary, supposes it to be an obsolete constipated vessel. A great deal might be advanced in favour of this last opinion; for, as plants annually form

* Soft down, *(pappus)*, and the fleecy covering of several seeds, appear to be only protracted secondary vessels.

new vessels, the number of fibres appears to be encreased by the old vessels. Notwithstanding, however, it is alleged, by others, that fibres, at their very origin have been found constipated between the leaves of herbs.

But, even, should future observations lead us to regard this fibre as a constipated vessel, still it appears certain that the skin of the vessels themselves is of a muscular nature, as it is capable of contracting and expanding in a regular manner.

§ 243.

Glands (glandulae) are in vegetables of multifarious situation and figure. Though their internal structure continues, upon the whole, pretty equal, they have not the most distant resemblance to animal glands, and their having the same designation is entirely owing to their being more or less roundish elevated bodies. They are found internally and externally according to their situation. Internally, they are situated in the cellular texture, or fleshy part of vegetables, and are found, of a globular, somewhat oblong and lenticular figure, in the middle or the partitions of the cells, as also in the inner bark. Externally, they are discovered in all parts of vegetables, either half sunk in the cuticle, rising to the surface or possessed of stalks. They have then a very extensive variety of shape, sometimes they are perpendicular, oblong, or depressed, sometimes very elevated and pointed, having their upper part furnished with a small hole, or even surrounded with an elevated margin. The different species of glands are exceedingly numerous, and may be distinguished by calculating all the varieties. Being sometimes more, sometimes less obvious, they are in the Hypericum *perforatum* considered merely contrary transparent particles, which are visible when exposed to the rays of light. In the Hypericum *montanum* they are easily observable by their brown colour, and in the genera Passiflora, Mimosa and Croton, their magnitude is sometimes so very considerable, that the mere touch of them serves to convince us of their existence.

Glands consist, internally, of a dense cellular texture which is too dense in proportion to the middle. Immediately under their skin, and upon the vertex, they contain a matter more or less coloured, odoriferous or insipid, according to the variety of the plants. The glands, which are situated in the interior of the plants, have no connection with the vessels, but glands, which are evidently situated on the outside of vegetables, have spiral vessels pressing forward to their centre, and then returning in a retrograde direction.

§ 244.

The anastomosis of vessels in the vegetable kingdom is totally different from what it is in animals. The adducent, reducent, and air vessels uniformly run in bundles through the vegetable body more or less perpendicularly; these separate into smaller bundles, which unite with the nearest body, and out of these still smaller ones adhere to a greater body; so that, upon the whole, by the separation and union of the bundles, a reticular appearance is produced. Lymphatic vessels, however, run singly, and anastomose like the vessels of animals, their boughs really uniting with the others branches.

§ 245.

After these general discoveries made by physiologists in the vegetable kingdom, it will be proper regularly to examine the most remarkable phenomena which have been observed in vegetables from their origin out of seeds to their decay, and briefly to comprehend the inferences which hitherto have been drawn, that the recurring scenes of life and death in all their various forms may thus be more fully elucidated.

§ 246.

The structure of the seed has already (§ 116), been explained, and we know that it serves the same purpose as the egg of animals, *i. e.* it contains the rudiments of a new being perfectly similar to its parents, and waiting only for a favourable opportunity of being evolved. All plants are propagated by seeds, and we may boldly exclaim with Harvey *omne vivum ex ovo.* It cannot indeed be denied, that they have not been found in *all* plants, but their existence in Mosses, Liverworts, Mushrooms, and many others, where formerly it was obstinately disputed, has, by the unwearied diligence of philosophers, now been completely ascertained; and we have no doubt that they will one day be observed in those where at present they are merely supposed to exist. Agreeably to the eternal, and immutable laws of nature, we observe, just as in the animal world, the same species arising always from the seed, and no other vegetable can ever issue from it, how different soever may be the circumstances of its germination.

The sketch of the shoot is narrowly circumscribed by nature, and nothing is capable of producing an alteration in its parts. The same form will be retained, and propagated for ever.

A seed has integuments, corcle, and cotyledons, (§ 116). It is fastened, as mentioned in the place referred to, by an umbilical cord; and as soon as this separates, a cicatrice remains called the eye, *(hilum).* In its vicinity lies the corcle. In the hardest seeds this last spot is the only one not covered by the internal hard membrane.

When the seed is placed in the ground, moisture soon pervades its substance through this aperture, assisted by the warmth of the atmosphere. In the corcle and cotyledons, all the described vessels are present. In the last, the adducent and air vessels divide themselves into numerous bundles, which frequently anastomose in the manner peculiar to the plant, (§ 244). A cellular membrane covers on both sides those vessels which spread on one plain surface, and contains the reducent vessels. On both surfaces the lymphatics spread out and surround the apertures of the cuticle. The pervading moisture is communicated to the vessels; the water is decomposed by them, and hydrogen and oxygen transpired. Carbonic acid gas, which seems to be shut up in the neighbourhood of the umbilicus between the external and internal membranes of the seed is likewise partly set free. The intercepted air which was received from germinating seeds, contained in 10 cubic inches, sometimes 2, sometimes 3, 5, even 8 cubic inches of carbonic acid gas; and from 5 and 6 to 8 cubic inches of azote and hydrogen gas mixed. This gas, when mixed with atmospheric air, explodes at the approach of flame. The rest of the undecomposed water, with the fixed part of carbon and hydrogen, pervades the vessels more and more, reduces the substance of the seed to a milk-white fluid, occassions a stimulus, and by the irritability of the vessels, excites the action of the vital power. The vessels, filled with their sap, carry it to the corcle, which is elongated by it, and converted into a plant.

The corcle consists, we know, (§ 116), of the rostel, *(rostellum)*, and the plumule, *(plumula)*. From the first arises the root, from the last the trunk, or the part above ground. Cutting a germinating plant in a perpendicular direction, so as to divide it into equal parts, we observe in the middle of each cotyledon a hollow channel which is called the chyliferous duct, *(Ductus chyliferus)*, which is continued as far as the beginning of the rostel, proceeds between its pith and fleshy substance, and at last incloses the pith. This duct serves to convey the nourishing fluid, which the cotyledons contain, to the young plant. Experience teaches us, that germinating plants, even though they have some leaves already evolved, cannot part with their cotyledons without endangering their lives, like a young animal which cannot want the feeding breast of its mother *.

§ 247.

It is a remarkable phenomenon in the germination of seeds, that the radicle first elongates, and pushes into the earth, where as soon as it fixes itself, the plumule appears in its peculiar shape, (§ 249). Even though the seed should be inverted and put into the ground, so as to turn the rostel towards the surface, yet it never will grow upwards. It grows long, but soon turns the seed, and goes into the ground, so that it recovers its proper position. This observation, which may be made every day, especially in the kidney bean, (Phaseolus *vulgaris)*; in the common bean, (Vicia *Faba)*, and other culinary seeds, has greatly attracted the attention of botanists. Dr Percival explains this by instinct, and endeavours to prove thence that plants have sensation and consciousness. Hedwig offers two reasons by which this tendency of the rostel downwards may be explained: In the first place, the sap is, by the two

* According to my own experience, the rostel dries up entirely, if immediately after the seed begins to germinate, we cut off both cotyledons, and all vegetation ceases. Fabroni, however, says, that a young plant may lose half of its cotyledons without any bad effects, and he even has cut off the whole, and the vegetation went on. But probably this experiment was made on plants where the plumule was already somewhat large. Hedwig observes, that the plumule may be cut off, and that in its place two young shoots will appear. I doubt very much if this be the case with all plants.

chyliferous ducts accumulated in the extremity of the rostel, which therefore becomes heavier, and according to the laws of gravity, is drawn downwards. In the second place, the moisture in the extremity of the rostel, is attracted by that of the ground. But both these reasons appear to me to be insufficient to explain this phenomenon ; for first, the power of gravity and attraction is one and the same power ; and secondly, the cotyledons contain by far more moisture, and possess a greater absolute gravity ; but notwithstanding this are often by the rostel pushed above ground. We are in fact as little capable of accounting for this phenomenon, as of giving the precise reason why several caterpillars spin a case, while others bury themselves in the ground. We are ignorant of the nature of this as of many other operations in organized bodies. The only way of hiding our ignorance is, to consider it as an action of the vital power. Dr Percival's assertion is a very precipitate conclusion, which deserves no attention.

§ 248.

It is to be observed, that seeds are not all provided with the rostel, especially those of some aquatic and parasitic plants, and perhaps all those which Dr Gaertner styles *acotyledones*. I was, as far as I know, the first who discovered this, by examining with great care the water-caltrops, (Trapa *natans*), one of the most singular plants. The nuts, as they are called, of this plant, when they lie in water, the natural habitation of the plant, shoot forth a long plumule, which in a perpendicular direction rises towards the surface of the water, its sides pushing out at certain distances, capillary, branched leaves. Some of those leaves bend downwards and take firm root at the bottom. In this case then the plant becomes fixed in the ground, not by a peculiar root, which like the rostel, pre-existed in the seed, but only through the leaves. It would be as difficult as in the rostel, to state the reason, why some of the undermost leaves bend downwards, and by their capillary extremities shoot forth roots.

From this, however, we are enabled to conclude, that some seeds may support the want of the rostel; but that, a germinating seed can exist without plumule and cotyledons, is a supposition altogether inadmissible. Nobody as yet has attempted to deny the existence of the plumule in any seed. Linné, Gaertner, Jussieu, and many other botanists, denied that, of the cotyledons, especially in the plants belonging to the class Cryptogamia, (§ 142). Jussieu alone adds to those plants which have no cotyledon, Gaertner's acotyledones, such as want the rostel. Nature has provided plants with their cotyledons, that these might nourish the young plant in its tender infancy. Never yet have I met with a single instance where this wise measure of nature was omitted. I examined purposely all those plants which were said to want the cotyledons, and always found them. That in some plants the existence of the cotyledons was altogether denied, and others were said to have one only, others two, and several plants more than two, arose partly from inaccurate observation, partly from mistaking a part of the plumula for a cotyledon. Placenta or cotyledon, (§ 116), is the name of the whole substance of a seed, not including the parts of the corcle. It rises in many plants with the plumule above ground, and is converted into leaves; or, it remains in the ground, and, as in the gramina and lilies, the first leaf of the plumule only rises, and this is what some thought to be a cotyledon. In flax and the species of fir, both cotyledons are converted into leaves, and the leaves of the plumula are evolved immediately after them, and are of the same magnitude and appearance. Hence it was, that botanists supposed there were many cotyledons. The division, therefore, of plants in acotyledones, monocotyledones, dicotyledones and polycotyledones, is erroneous.

§ 249.

I am acquainted only with three varieties, which are discovered in the cotyledons of the germinating seed. The cotyledons are either split into two parts, or they adhere so firmly to one another, that they cannot be separated. In the first case, they grow out of the earth, till they become visible, and assume the appearance of leaves: these are denominated by botanists dicotyledones, and the same process takes place in the most of plants. As a very common example, I may adduce the kidney bean, Phaseolus *vulgaris*: In the second case, they remain in the ground, and only the plumule grows up, as in in the vetch, Vicia *Sativa*, in the pea Pisum *sativum*, in all the gramina, lilia, &c. In the third case, the cotyledons, or the two halves of the seed, are not divided, but pushed upon the ground, and on their side the plumule is evolved, as in Juncus, &c. &c. I have not been able to perceive any more varieties (§ 116), and every one may easily satisfy himself of the truth of what I have mentioned.

I have observed, according to the changes in the cotyledons, five principal varieties, which I call membranous corcles, *(dermoblastae)*; filiform corcles, *(nemoblastae)*; split corcles, *(plexeoblastae)*; earth corcles, *(geoblastae)*; and globular corcles, *(spheroblastae)*.

§ 250.

Dermoblastae, I call such as have the cotyledon in form of a membrane, which bursts in an irregular manner. This membrane is found in the Fungi, where, in general, it disappears immediately after their evolution.

We would require still further observations on this point, especially in the small Fungi, and even in these, different modifications may possibly appear; but this is merely a supposition about which nothing certain is known. Most of the plants which have this peculiarity are so very small, that their existence and characteristic varieties can be perceived with difficulty, much less is an accurate knowledge of such very minute plants to be expected.

§ 251.

Nemoblastae. These appear in Mosses and Filices, and may perhaps be found also in Algae. To prove their existence in the last, however, we still need more accurate observations. The substance of the cotyledon in them divides into two halves, and bursts into an irregular shape, resembling threads*.

§ 252.

Plexeoblastae, are those in which the cotyledons appear above ground in two parts, and change into leaves, which are of a different shape from the rest of the leaves. They are elliptic in the species of Phaseolus; linear in the umbellatae, and in the Plantago; cordate in the plants of the sixteenth class of Linnaeus; inversely cordate in those of the 15th class; reniform in the ringent plants; wedge-shaped, and at the point variously intersected, in the lime tree †, &c.

* Some young species of Manna germinate in this manner. It appears to me that in the genus Lichen, the plumule expands into a flat lobe, but that the cotyledons grow up, and are not separated. In such circumstances it would belong to the Geoblastae.

† The Filices, which I have often seen germinate, belong to this division, only with the following difference. The two cotyledons either separate and become two leaves, or they separate only in part, remaining connected together below, and are changed into an infundibuliform leaf.

§ 253.

Geoblastae, are those which keep the substance of the cotyledons under ground, *e. g.* the vetch, pea, the gramina, lilies, &c. They are of a double kind.

Rhizoblastae, where the seed has a rostel, and shoots down a straight root, as in most plants belonging to this class.

Arhizoblastae, when the seed wants the rostel, as in some aquatic and parasitic plants *.

§ 254.

Sphaeroblastae, are those whose cotyledons are not disunited, but which come out of the ground in form of little globules fixed upon a small stalk, and have the plumula on their side. This we meet with in Juncus *Bufonius subverticillatus*, and some plants related to it. Several botanists who were unacquainted with this singular mode of germination, have mistaken the above-mentioned plant for a new one belonging to the 24th class of Linnaeus.

§ 255.

It has long been known, that every plant affects its own peculiar soil, and that on this account, seeds do not germinate in all kinds of soil, at least they soon decay in a disadvantageous one. Various trials have been made, to make seeds ger-

* I have observed Riccia *cristallina*, Marchantia *polymorpha* shoot from seeds, and can safely affirm that they belong to this division.

minate in various matters, different from the usual earths. Sukkow made sallad plants grow in pounded fluat of lime and barytes. Bonnet made plants grow in saw-dust, slips of paper, cotton, and even in an old book. That cress, (Lepidium *sativum*), germinates upon a piece of woollen cloth, is a well known fact. Mr Humboldt's experiments to make seeds germinate in metallic oxyds, especially the red oxyd of lead, and massicot, &c. are more instructive. In powder of coal and sulphur, seeds germinated likewise very well. He found that oxygen proved an extreme stimulus to plants, and that without it they never can be brought to germinate. On this account germination went on quickly in metallic oxyds, especially in minium. In oil, on the contrary, carbon, hydrogen, in the filings of lead, iron, and copper, as well as in powdered molybdene and in alkalis, no one seed germinated. It soon occurred to him, that with oxygen as a stimulant he might forcibly make seeds germinate faster, and he actually found, that at the temperature of 20° Reaum. all seeds vegetated most rapidly when steeped in oxy-muriatic acid. One instance alone will suffice. The seeds of the Lepidium *sativum* germinated after 6 or 7 hours, when put into oxy-muriatic acid; whereas, when lying in common water, they required from 36 to 38 hours. In a letter dated February, 1801, he writes to me, that in Vienna they derived much benefit from the discovery of this fact, and that seeds twenty and thirty years old, brought from the Bahama islands, Madagascar, &c. which constantly refused to germinate, very readily, in this way, vegetated, and produced plants which grew up very successfully. The Mimosa *scandens*, which as yet is not to be found in any botanic garden, grew very well with this acid. As every gardener cannot obtain the oxy-muriatic acid, Mr Humboldt proposes a very easy method to procure it without difficulty. He took a cubic inch of water, a tea-spoonful of common muriatic acid, two tea spoonfuls of oxyd of manganese, mixed it and placed the seeds in them. The whole was now allowed to digest with a heat of 18—30° Reaum. In this the seeds germinate excellently; but it is necessary to take the seeds out, as soon as the corcle appears. That the seeds are not injured by the acid, is proved by the many plants which have been treated in this way, under the inspection of Mr Jacquin, and in which vegetation went on extremely well.

It is the oxygen of the atmosphere which stimulates the seed to germination. And this explains at once the experiment of Mr Achard, why plants vegetate faster in very compressed air, than in air in its common state.

Besides oxygen, ammonia too favours the germination of seeds; hence they germinate almost immediately when placed in dung, which therefore serves as manure. Cow-dung, we know, consists of muriatic acid and ammonia. In fluids which contain no oxygen, seeds will not germinate. Thus they never germinate in oil, which consists of hydrogen and carbon.

§ 256.

It is the rostel of seeds which produces the part of a plant under ground, and which is called the descending stem or root, (§ 10). But physiologists call that part only a root, which carries nourishment from the soil to the plant, or what we before called radicles or fibres, *(radicula)*.

In under shrubs this stem descending under ground consists of a bulbous, tuberous, fibrous or oblong root. In annual plants it is more or less perpendicular; and in shrubs and trees its formation entirely resembles the stem. In this, foresters again distinguish two separate parts, the thick one, which descends perpendicularly, called the main root; and those parts which run forth horizontally in the earth, which are their horizontal roots.

§ 257.

Anatomy shows us, that in herbaceous and biennial plants the adducent and pneumatic vessels form a circle in the root, the inside of which is close compressed, the outside lined with cellular texture. The reducent vessels lie in this last; the lymphatics without apertures in the epidermis. Roots are quite destitute of pith; we never meet with more than one vascular circle, for as the duration of the first is only that of a year, or a few months, the new circle cannot attach itself to the old. One exception to this we have in the beet, (Beta *vulgaris)*, which is a biennial plant; its root, when about a year old, has from five to eight of these vascular circles, as is abundantly evident to any one who has observed the beet. It follows, therefore, that beets produce them more than once, and they make an exception to the common rule, which is worthy the notice of physiologists.

§ 258.

Under shrubs, which have no bulbs, knobs or creeping roots, are provided with a concentrated circle of adducent and air vessels, which is surrounded with a strong cellular texure inclosed in the external integuments. Like all other roots they are quite destitute of the tube of pith. A new circle is formed every year in such a manner that, at the part which lies nearest to the surface, we can determine precisely the age of the circle by the number of the rings. The smallest roots last many years, and are according to the difference of the species revived by new roots which supply the place of the old ones when decayed.

This is different in the creeping, tuberous and firm bulbous roots. They have, according to their species, their vessels in a circle closer to the centre, or more or less distant from it. They are, however, annually renewed, and the old ones die. On this account we find in most of them, for few live more than one year, only one circle.

Bulbs, (§ 53. 1. 2. 3.), have at their base a fleshy bottom, from which radicles and new bulbs shoot forth. This consists of a reticular plexus of vessels, which are not circular as in other roots.

These plants change their station, and in common animals, move from one place to another. The creeping root runs forth under ground, the branch from which the new shoot arose dies, and the young root now becomes attached to a distant spot. The palmated and testiculated root, (§ 12. n. 35. 36.), consist, as we saw before, of two knobs, one of which completely dries up, and on the opposite side a new one is formed. This happens every year, and the plant in this way, after many years, appears on a different spot. Solid bulbs, (§ 12. n. 47.), especially the bulb of the Colchicum *autumnale*, undergo the same change; on the side of the old bulb a new one appears, the old one decays, and the whole at last becomes attached to neither place, and this is the case with most bulbs and tuberous roots *.

§ 259.

Very remarkable, and deserving particular attention is the choice of food, which has been observed in some of the creeping roots. A strawberry plant, in a garden of excellent soil, was planted in a particular spot filled with sterile sand. Stalks and roots all grew out towards the sides where the good soil was, but the main plant decayed. Several other remarkable instances are, at present, inexplicable, so little do we know of the physiology of plants.

* The bitten root (§ 12. n. 8.), has at first a perpendicular direction. After the first year the perpendicular root becomes ligneous, and on its sides new branches shoot out. The old main root must decay, and consequently putrifies; and this gives it its peculiar form.

§ 260.

The descending stem, (§ 10), is probably composed of the stalk of the root, radicles, knobs or bulbs of various form, and these parts are almost always covered with fibres, which, like leaves, are renewed every year.

In spring and autumn, and even in winter, when every thing is covered with snow, new ones, in cold and temperate climates, spring in place of the old dry ones. In warm and hot climates this happens during the rainy season, therefore always at a period when the vegetable world appears to sleep. The radicles grow in the following manner: a small bundle of air-vessels lengthens, pierces the cutis, and runs into the ground. It is enclosed in a delicate cellular texture, covered by a thin membrane. Thus the extreme point of such a radicle is merely the end of the spiral vessels, which absorbs the necessary food from the soil. Those fibres, which are never wanting in earthy plants, cannot perform this function of taking up food longer than one summer, after which they must be succeeded by new ones.

§ 261.

All plants do not grow in earth, and therefore the roots of some does not enter the ground. The parasitic plants are of this kind. The Cuscuta *europoea*, when it germinates, lengthens its filiform plumule, winds round neighbouring growing plants, as flax, nettles, &c. and runs along them. Its rostel decays, and along the whole surface of the filiform branching stalka kind of warts shoot out, where it rests upon the other plants, serving as roots. Algae, but especially Lichens, are, by similar warts, attached to the trunk of trees, and few pierce their external membrane. The Sphaeriae grow mostly on the inner bark of old decayed trees; they pierce or elevate the external membrane, and are firmly attached by wart-like roots. The misletoe, (Viscum *album)*, pervades with its roots the woody part of branches, and becomes intimately blended with it. Amongst the numerous species of parasitic plants which the torrid zone produces, one species is particularly distinguished, which grows abundantly in the Indies beyond the Ganges, the Epidendrum *flos aëris*, for it grows and blossoms in the air, when hung up in a room. Mr Loureiro, who saw this himself, assures us, that it vegetates hung from the ceilings of rooms for years, and is remarkably reviving to the inhabitants by the fine odour of its blossoms.

Lantaria chinensis and Rhapis arundinacea, as well as some other small palms, are remarkable from having a part of their root next the stump, springing from the earth, whence they have the appearance of being attached to a withered stump.

§ 262.

The root is indeed, in the strictest signification, the plant itself. The stalks, leaves, and flowers issuing from it, are only its elongations which it makes on purpose to get proper nourishment. These may be cutoff, and the root will always again throw out new elongations. The root may be divided, and each part will form a plant by itself; not so the stem, except in some ligneous plants, where the stem is merely the root elongated. Resinous or dry plants, as Pinus, Erica, Rhododendrum, are an exception to this, as in them the stem can rarely be injured, without injuring the whole plant.

§ 263.

Many experiments made by inverting plants, prove clearly that the descending stem is not different from the stalk above ground. If a plumb or cherry tree, not too thick, be bent with its top towards the ground in the autumnal season, one half of the top buried in the ground, and one half of the roots carefully taken out of the earth, covered at first with moss, and then gradually left quite uncovered; if afterwards, in the following year, the same is done with the rest of the top of the tree and the roots, the tree will shoot forth leaves on the branches of the root, and roots from those of its top, and in due time the root will come to blossom and bear fruit. A willow is best adapted for making this experiment in a short time, and with success*.

§ 264.

We have seen, that the root arises from the rostel of the seed, and from the plumule, which is always

* Counsellor Medicus has made this observation, that the pith of a stalk planted in the ground, in becoming root grows dry, and at last decays. But whether the roots of ligneous plants which are raised above ground, receive pith in assuming the appearance of stalks, is not sufficiently ascertained.

bending uppermost, the upper part of the plant above ground, whatever its shape may be.

The stem of herbs and shrubs, as well as the trunk, the scape and the stalk, in short, all the varieties of the stem, have a channel full of pith, surrounded with a ring of adducent and air vessels. In the cellular texture lie the reducent vessels. The cellular texture, and membrane full of lymphatics, enclose the whole. The ring which the larger vessels form, accords with the form of the plant, triangular, pentagonal, or hexagonal.

The same happens in the growth of the stems of trees and shrubs during the first year. Every year a new bundle of adducent and air vessels in a circular form is added externally to the old ones. The innermost bundles of vessels are more and more compressed, till the pith at last, except where this is natural to some shrubs and trees, entirely disappears, or is compressed to a very small point. The interior vascular circles become annually more dense, and at last get so hard, as to form what is called wood. The less, or half-indurated external circles, constitute the alburnum, and the outermost one, which is just newly formed, is now called the inner bark. This last, then, is a circle round the stem of the tree, consisting of numerous, young, new-formed vascular bundles. It is divided into two parts, the exterior layer changing into bark, the interior first forming the alburnum, and then the wood. The bark, in ligneous plants as well as in herbs, is green and vascular; but as soon as it grows older, its green colour changes into brown; still the lymphatics retain their power. But the more the tree advances in age, the browner and darker the bark grows; it cracks, and the function of expiration cannot go on as before, nor are the vessels in the cuticle any longer visible. Some trees and shrubs lose their bark annually, and reproduce a new one from the inner bark. As instances may be given, the Platanus *occidentalis*, and the Potentilla *fruticosa*.

The age of a tree or shrub may be easily determined by the number of these ligneous circles, upon cutting the stem off, close to the root. In the same manner the main root shows most accurately the age by its ligneous circles, when cut directly below the surface of the ground.

In the Palmae, however, according to Daubenton's observation, this is very different. For if we cut a stem horizontally through, we find no difference between an old or young tree. In them the vascular bundles do not dispose themselves in a circular form. They consist of vessels running in a straight line, without regular order, and enclosed by a cellular membrane. Nor do they grow thicker annually or possess proper bark, but this is formed by the remnants of the leaves. Daubenton is not inclined to assign the name of wood to their substance, and proposes, if it were to be given to their fibrous substance, the name of *lignum fasciculatum*, to distinguish it from the common wood, which he calls *lignum reticulatum*. As the Palmae are destitute of branches, their leaves do not arise from buds, but are in fact only small separated bundles of vessels of the stem, which expand in a leafy form. Hence it is that the under part of the petiolus remains and forms the bark.

§ 265.

If the vascular bundles of a tree or shrub remain in a straight direction, the stem ascends without forming any branches. The new shoots in the hazel, (Corylus *Avellana*), Berberis *vulgaris*, and all which the trunk of trees produced when lopped, are a proof of this. As soon, however, as the air-vessels become convoluted, and form a knot, branches are formed. By assistance of art such straight shoots may be brought to branch, by making a transverse incision through their bark. The separated air-vessels heal the lips of the wound, are several times convoluted, and growing larger are obliged to form more gems from which branches arise.

§ 266.

The growth of ligneous plants admits of five varieties:

1. Trees and shrubs, *(Arbores et frutices)*, have their stems beset with leaves. On the base of each petiolus a bud or gem is formed, which again becomes a leafy branch, provided with gems formed in the same manner. If the main shoot grows at first in a straight line to a certain height without the buds on its sides being able, on account of the too hasty circulation of the sap, to form themselves into branches, or these, should they really be formed, not be able to grow any more, such a plant then becomes a tree, which has a straight and simple stem, with a

branching divided top. But if the stem divides near the root, when the sap circulates more slowly, and each bud can unfold a branch, then this plant is a shrub. By means of change of soil, place, climate, and by art, trees may be changed into shrubs, and *vice versa.*

2. Under shrubs, (*Frutices minores*), have very leafy branches, which, however, are very small, and only deposit a very delicate circle of vessels. Hence every bud attached to a petiolus is not then really evolved, as their branches are very few. They are besides, as their branches are so delicate, of short duration, and often replace their old decayed branches, by young shoots from the roots.

3. The pine tribe, (*arbores acerosae*), have, however, very leafy branches, which on their extreme points only, and on one spot, evolve several buds, of which that in the middle grows in a straight direction, the other unfolding on its sides. Hence the appearance of some pines like that of a twirling stick, by which, as every year a new one is added, the age of the tree may be found.

4. Shrubby gramina, (*gramina fruticosa*), have a knotty culm, with attached and dispersed leaves. Each knot sends forth branches, but without a knot no branches appear.

5. Palmae et Lilia *frutescentia.* These have a simple stem, which has leaves only at its top; and if this is injured, the stem decays. The last sometimes retain their life by lateral branches, but with the loss of the beauty of their growth and appearance.

Besides these varieties of ligneous plants, there are many which make a transition from one to the other.

§ 267.

The Palms are incontestably the most beautiful of all ligneous stems, which kind nature has bestowed on the warm climates exclusively. But after them, the particular growth of some West India trees, which are not of the palm tribe, deserve notice. To those belong the genera Theophrasta and Spathelia. They have a simple, very high, branchless stem, which in its whole surface is ornamented with bundles of leaves. How wonderful must be the appearance of a landscape with groupes of such trees!

A tree which grows in Africa, on the Senegal, presents the most irregular appearance, and without question is the thickest tree on the globe. It is the Adansonia *digitata.* Its stem is only ten or twelve feet high, but so thick that its diameter is found to be from 25 to 30 feet. Its circumference, therefore, is from about 75 to 90 feet. Its top is very remarkable, for numerous and thick branches, of from 30 to 60 feet in length, run out from it in all directions. We ought, therefore, not to be surprised that sometimes the hollow trunk of the Adansonia is the abode of several negro families.

Not less wonderful is the tree called Rhizophora *mangle,* which bends its branches perpendicularly to the ground, and changes them into stems, so that one single tree covers the muddy rivers under the tropics of Asia, Africa, and America, for more than a mile, with a forest consisting of numberless stems, which at the top have the appearance of a close-clipped bower.

§ 268.

But there are varieties of stems, which at first sight scarcely would be counted as such; and which also in regard to the structure of their vessels, are different. The whole genus Cactus with its varieties is an instance of this kind: fig. 233, represents a stem of it. The different links which commonly are taken for leaves, are parts of the stem. The leaves themselves are subulate, fleshy points, which on their base are covered with small prickles. They fall off, as soon as a bark is properly formed, and their former place is marked by the remaining bundles of prickles. The stem of some species of the genus Euphorbia, Cacalia and Stapelia, is of the same nature. The links of the stem consist of a double network of air and adducent vessels; the whole is surrounded with a dense, cellular texture, or a fleshy substance, and the cutis itself, has net-work of lymphatic vessels with apertures.

§ 269.

The thorn, (§ 67), is, with regard to its anatomical structure, to be considered as a ligneous stem, and does in no respect differ from it. It arises generally from an incompletely evolved bud, which has begun to form itself, but wanting a proper supply of nourishment, remains only in form of a very short, sharp, and bare twig. It is like the woody stem of a tree or shrub, formed of the air and adducent vessels, which have grown completely hard. It therefore remains fixed, though the bark be taken off. That it arises from a want of food is easily proved by the cultivation of thorny plants. Most species of our fruit trees have thorns, but having been supplied in our gardens with extra food, the thorns become boughs, and at last disappear entirely. Only such plants as the black thorn, which are almost covered with thorns, do not lose them entirely by that treatment, though their number is always diminished.

Nearly the same thing takes place in thorns, which are not formed from imperfectly evolved buds, but are other parts of plants, changed in their appearance. Sometimes the petioli of pinnate leaves, when they remain after the leaves have dropped off, become thorns, as in Astragalus *Tragacantha*, and other species of that genus. On the petiole they grow larger, sharper, and assume, after the flower and fruit have fallen off, the shape of thorns; for instance, Hedysarum *cornutum*: or lastly, the stipulae become sharp, ligneous, remain and change into thorns, for instance in the Mimosa. Such changes, which frequently occur, especially in oriental plants, remain uniform or constant.

§ 270.

The prickle, (§ 68), is a prolongation of the cutis, and can therefore be taken off along with it. This consists of reticular, more or less expanded, adducent vessels, and a few air vessels, and is covered with the vascular cutis. The most careful cultivation cannot convert a prickle into a shoot, as its air vessels become very rapidly ligneous, and separate from the inner bark, and it is therefore only kept from dropping off, by the covering cutis. Prickles have sometimes a peculiar shape; they are almost of the shape of contorted tendrils in Nauclea *aculeata* and other plants. Even the stipulae of some plants are converted into prickles, for instance, Robinia *pseudacacia*, Berberis *vulgaris*, &c.

§ 271.

Tendrils have the same structure of vessels, in herbaceous stems. They are, in fact, petioli, (§ 62), without the leafy expansion, but which, having not wasted their sap in the formation of leaves, have grown longer, and on this account have become too feeble to keep their straight direction. Hence arises their twisted shape. It appears, as if the diminished force of the current of air had a particular influence upon the tendril. For each plant that supports itself by tendrils, when distant from a wall, tree or shrub, sends out all its tendrils towards that side on which the plant is to attach itself. At least this phenomenon can scarcely be explained in any other way.

§ 272.

The pith which is found in the centre of stems, (§ 232), is a spongy cellular texture, which commonly is of a remarkably splendid white colour. It is not the least different from cellular texture, and in no respect like the spinal marrow of animals. Nature seems to have provided plants with it on purpose to deposit in it a store of moisture, that they may not suffer during drought. Hence all trees and shrubs have it, but as soon as they grow older, they need it no longer, the wood being an excellent substitute. On the same account it is unnecessary in water plants, as they very rarely suffer from drought; all of them have a hollow stem, without any pith.

§ 273.

The gem or bud is the embryo of a future branch, and its anatomy, therefore, perfectly coincides with the anatomy of the stems and leaves, as they are inclosed in it, in small compass. The period of their formation differs in different plants. In cold regions the bud is formed in autumn, covered with a great many scales, and so prepared for the mild spring. In warm and hot regions this is different; there no pernicious frost destroys the blossoms of the spring, and cold does not impair the vital power of the vegetable creation, therefore no precaution was necessary. The buds unfold themselves immediately from the bark into branches, without having remained there in the form of buds for any length of time. However, we meet with exceptions to this rule. Hot climates too, have some bud-bearing plants, and we possess a few shrubs, especially the Rhamnus *frangula*, which never buds. Each bud unfolds a branch with leaves, which at the base of each petiole, again produces buds. In this manner their growth continues. But this evolution of buds, from buds, would continue without stopping, were it not so regulated, that each bud, as soon as the blossoms and fruits are perfectly formed, decays. The evolution of the flowers, and afterwards of the fruit, constitutes the invincible barrier to the growth of the branches.

Each bud, like all vegetable productions, is formed by the spiral vessels. Cutting a bud in a transverse direction, a white spot appears, continued to the very extremity of the bud, and this snow-white continuation is nothing else than a bundle of air-vessels. If the same is done at an early period, an elongation of a small bundle of the spiral vessels is found.

§ 274.

The leaves are composed of the same vessels of which the root, stems, and other parts of vegetables consist. But the manner in which they are disposed presents a remarkable difference. A great bundle of vessels enters the base of the leaf, and divides on its surface in a reticular manner, anastomosing like plants, (§ 244). On this anatomosing of the vessels of leaves depends their form, and as it differs in each plant, we need not be surprised at the diversity of leaves. If the large vascular fascicle divides in three great divisions, a triangular leaf is formed; if it divides in more, then we see all the species of compound leaves arise, which we have described in the Terminology. If, for instance, the vascular fascicle at the base of the leaf splits into smaller ones, a nerved leaf is formed. But if it run straight forward, emitting single fascicles on its sides, then we have a veined leaf. If there are on the margins of the leaf numerous anastomoses, such a leaf is then called *folium integerrimum.* But if the fascicles spread in small unconnected branches towards the margin, the leaf becomes, according to circumstances, serrated, dentated, crenate, and so forth.

These bundles of vessels in leaves are composed of air and adducent vessels. The net-work they form, is in both its surfaces covered with cellular texture, in which the reducent vessels lie. And the external membrane or cutis which on both sides invests the cellular texture, is provided with innumerable lymphatic vessels, (§ 240), and their exhaling pores.

The footstalk of leaves resembles in its structure that of the stem, except that the air-vessels on its base by their convolutions form a knot, which serves for the evolution of the bud, their direction being thus changed. This knot is of the same nature as the supporter of a bulb. In rooty plants, radicles are observed to shoot out, as also in sessile leaves, or such as want the footstalk, we seldom find such a knot, and therefore they will not always produce buds at their base.

§ 275.

Of all the parts of plants, the leaves shew a particular irritability; especially in compounded leaves. Merely by touching the leaves of Mimosa *pudica*, *sensitiva*, *casta*, Oxalis *sensitiva*, Smithia *sensitiva* and many others, they instantly contract. If single leaves, or the main footstalk be touched, they remain contracted for some minutes.

Almost all triangular leaves, and leaves which are composed of several small ones, contract at night, like the above plants, in such a manner that one leaf covers the other, and the whole becomes compressed. Whoever will take the trouble to examine the plants of a garden at night-time with a lantern in his hand, will find several of them in this state, which has been called sleep, (§ 7). There are plants which, at a certain hour in the day, open and close their leaves. Du Hamel made experiments with the Mimosa *sensitiva,* which at a certain hour in the evening shuts its leaves, and again at a certain time opens them. He put this plant in a leathern trunk, covered with woollen blankets, and found that its leaves opened at a certain hour in the morning, and again were shut up in the evening. It has been alledged, that this phenomenon varies in its period, when going on in vacuo. A South American shrub (Porliera *hygrometrica*), uniformly contracts its feathered leaves, whenever it is going to rain, and is the surest foreteller of the weather that one can have.

A plant which grows in the marshes of South Carolina, Dionoea *Muscipula* has a singularly constructed leaf. At the apex of a lanceolate leaf an elongation is seen armed with short prickles, which as soon as an insect or other small body is put upon it, shuts itself, and does not open, till the body caught by it becomes quiet.

The species of Drosera *rotundifolia* and *longifolia,* the leaves of which are planted on their margins and surfaces with petioled glands, contract, according to Roth's observations, when stimulated, though very slowly.

A species of Filix in North America, the Onoclea *sensibilis*, has got this appellation merely from the circumstance, that its young leaves, when they begin to unfold themselves, shrink upon the least touch. In other respects, this plant shows no symptoms of irritability. The Nepenthes *distillatoria*, growing in Ceylon, has on the apex of its leaves a leaf-like *ascidium*, (§ 52), of which fig. 28. is a representation, which at times opens and closes, and is even filled with water. This takes place also in a species of this genus indigenous in Amboyna.

Of all plants, however, in this respect the most singular is the Hedysarum *gyrans*, growing on the banks of the Ganges. It has trifoliate leaves, of which the central one is larger than the two others. All these leaves move spontaneously. The large one rises backwards, up and down, the two smaller leaves at the sides have the same movement, only somewhat vigorous. Laying hold of these leaves, and then removing the hand, quickens their motions, as if they were to make up for the lost time, till at last they return to their former slower motion. No particular stimulus seems to act on them, and they do not contract like other irritable plants. Nor does this motion of the leaves depend on sun light, for they move in light as well as in the dark, even when the plant is perfectly asleep. It is besides remarkable, that the leaves in the height of erection, and during very warm days, like the animal muscular fibre, have a tremulous motion.

§ 276.

The stipulae and bracteae agree perfectly with the leaves with respect to anatomical structure. The floral leaves are sometimes coloured.

§ 277.

From what has been said respecting the internal nature and chemical constituents of vegetables, and from the general observations which have been made we are enabled, as far as these remarks extend, to form some conclusion respecting the vital process in plants. Like animals, they are provided with vessels, which contain juice; they are susceptible to the application of stimuli, and thus are irritable; they also correspond with animals in their evolution and formation. Hence, we might infer that they must have a circulation of sap.

In our days, hardly any one will support Jampert, in his attempt to prove on mathematical principles, that plants have no vessels, as their existence has been fully ascertained by Grew, Malpighi, Mustel, Moldenhawer, Hedwig, &c. &c. and as every one who doubts may be convinced of this truth by ocular demonstration. Physiologists, however, do not agree in every respect. Hales considered the motion of sap in vegetables as the ascent of a fluid in a capillary tube, and alleged that it was carried forward, merely by attraction, such as by light and heat.

Malpighi was the first who ascribed irritability to the vessels, and asserted that their diameter was contracted and enlarged. He even affirms, that he has observed in the spiral vessels, a peristaltic motion, similar to that of the animal intestines. But he must have been deceived here, as the spiral vessels dry immediately when exposed to the air, and roll together in consequence of their extraordinary fineness.

Corti admits the irritability of the vessels. Under the microscrope he pretends to have observed in the vessels of sixty-five plants a motion of the juice from joint to joint, and he supposes that every knot in unison with its interstice has a peculiar circulatory system quite independent of the other parts.

Miller adopted the opinion of Hales, that there was merely a rise and fall of the sap, without any fixed circular motion; that heat occasioned the rise, and cold the fall of the sap.

Walker, who attempted to investigate the motion of the sap in trees which bleed in spring, affirms, that in spring the sap first begins gradually to ascend into the root, and at last rises to the top, and that this depends on the temperature of the external air, but that the juices never descend. Owing to this, the buds at the extremity are developed first. The sap is supposed to ascend between the bark and the wood, but this effect is produced not by heat alone, but by its co-operation with an internal unknown cause. He does not absolutely reject the opinion of there being a circulation, but only supposes that the tree before its evolution has quite a different motion of sap from what it has when in leaf.

Various conjectures have been formed by other physiologists respecting the circulation of sap in the vegetable kingdom. Some think that the sap ascends only through the vessels of the inner bark. Others assert that it ascends to the wood through the roots and descends through the cortex. Of this opinion are those who have injected plants with coloured liquids. From their observations it would appear that the coloured juice proceeds from the substance of the root into the wood, and hence is communicated to the leaves, from which it finds its way back through the cortex.

§ 278.

Should we now admit with Hales, that the sap rises only by means of attraction, air and heat, in the vessels of vegetables; it necessarily follows, that the motion must be slower in spring than in summer. Now, according to Hales's own experiments, the rapidity with which the sap of the vine is moved in spring is five times greater than the circulation of blood in the arteries of a horse. This velocity diminishes greatly in summer, and in autumn quite disappears. If heat were the cause of motion in the vegetable juice, it should in summer, by the increase of warmth, be much stronger than in spring. And hence it is perfectly obvious that this phenomenon depends not on any mechanical cause, but simply on the irritability of the vessels.

Brugmanns has endeavoured to prove the irritability of vessels, by showing that the amputated branches of the Euphorbia *Lathyris* and *Myrsinites* which emit a great quantity of milk, cease to do so, as soon as the cut part is anointed with a solution of alum and sulphate of iron, so diluted that it leaves no stain on paper.

Van Marum repeated this experiment but did not obtain the same result. Uslar, however, has observed that the amputated stalk of Euphorbia *exigua* and *sylvatica* when immersed in a solution of alum or acetous acid, immediately, or at least in a short time after, ceased to flow.

Van Marum demonstrates, by several remarkable experiments, the irritability of vessels. He poured an electric stream over the branches of Euphorbia *Lathyris*, as well as through the whole plant of E. *Esula* and *Cyparissus*, for the space of 20 to 30 seconds. On intersecting them, it was found that they did not emit any milky juice, though, by compression, some of it was observed to drop. He made the same experiment on the boughs of the Ficus *Carica* which were exposed for 15 seconds to an electric stream. Girtanner asserts, that, oxygen is a stimulus to plants; that oxygen has a closer connexion with the vegetable fibre than with other bodies; that all bodies which rapidly absorb oxygen, are stimuli to plants, and must promote their growth.

According to this theory the experiments of Mr Humboldt which he made on the germination of plants, (§ 255) may be very well explained; and the observations of Ingenhouss and others confirm the opinion that corn and other vegetables, in a bad soil, when sprinkled with well diluted sulphuric acid, grow just as well as if they had been plentifully manured. We learn also from chemistry, that oxygen from the atmosphere very easily combines with the different species of earths and stone, particularly, with vegetable mould, (humus). It is well known to every gardener and forester, that trees planted in spring grow so much better by having had their holes digged in autumn, which during the winter were exposed to the influence of the air. Experiments have also shown, that soils which have been dug into loose heaps of earth frequently stirred and then exposed for half a year to the influence of the air, produce a richer crop than if they had been manured, and retain this fruitfulness longer than by the application of manures.

§ 279.

But besides the mere oxygen, there are other bodies which act as stimuli upon plants. Most of these, however, appear only in an active state, for this reason, that they either contain oxygen or dissolve it.

Well or river water, considered as an aliment, being decomposed in the vegetable process, sometimes also constitutes a stimulus. Rain water is much more beneficial to plants than any other, because, according to Hassenfraz's investigation, it contains more oxygen. Caloric is an excellent stimulus to vegetables, as it renders oxygen gaseous and moistures more fluid: consequently, the influence of this matter becomes more powerful. Only, the degree of it must be proportioned to the vegetable fibre. Thus plants at the tropics will sustain more heat than mountain plants or those at the poles.

Muriate of Ammonia, according to Brugmann's observations, promotes vegetation. The branch of a service tree was put into pure water, another into a solution of muriate of ammonia; in 24 hours the former imbibed 5-12ths, the latter 10-12ths of the liquid; and hence we may draw the probable conclusion that the muriate of ammonia, by its stimulus, increased the activity of the vessels. Nitrate of potash is used by the Dutch gardeners as a means of promoting growth. The bulbs of narcissuses, hyacinths and other vegetables, grow much faster in water where this neutral salt is dissolved. Tromsdorf found also that a sprig of the Mentha *piperita* became 378 grains heavier in a solution of nitre, whereas, a sprig in common water gained but 145 grains in weight. Barton however, directly maintains the contrary, because a few grains of nitrate of potash killed a Kalmia. But it is easy to conceive that a moderate stimulus to some plants, may be over violent and destructive to others.

Barton found that in water in which camphor was diffused, a decayed twig rapidly recovered, which did not happen when it was placed in common water. A decayed branch of Liriodendron *tulipifera* and a withered flower of the yellow Iris recovered in it and remained long fresh. I myself tried this with a branch of Silene *pendula*, the flowers of which were quite shrivelled; in an hour's time I found the petals again perfectly expanded, as if just evolved. Is it the hydrogen of the Camphor which stimulates the vegetable fibre to such a degree, as to produce this phenomenon? or is it a consequence of the composition of the camphor, that only the exact proportion of carbon, which is found combined with hydrogen in camphor, can stimulate the fibres? This remains to be determined.

Light likewise is a very powerful stimulus of the vegetable fibre. Every body knows that hot-house plants incline their stalks and leaves always towards the windows. A plant which has been confined for days in a dark room will, as soon as some light is admitted, however small the aperture be through which it passes, bend its stalks towards the light. Who does not know, that the species of Lupinus, especially Lupinus *luteus*, turn in the open air their leaves and stalks towards the sun, and follow its course in so steady a manner, as to enable us to specify the hour of the day from their direction?

Light is farther of particular service to vegetables in promoting the decomposition of the absorbed water, and separation of the oxygen; for when this oxygen gas is accumulated in vegetables, all their parts become white, as may be seen from plants which vegetate in the dark. Even the light of a lamp effects the separation of the oxygen, as an experiment of which I was eye witness, fully proves, viz. that of Mr Humboldt, who rendered Lepidium *sativum* which had grown up in a dark cellar green, by the faint glimmering of a lamp kept under it several days.

All plants cannot support the stimulus of strong and constant light. There appears to be a determinate degree of this stimulus, which they cannot, without injury exceed. As young plants are much more susceptible than grown up ones, they thrive best in the shade. All forest plants are destroyed by too much light. This is proved by the observations of Medicus, Desfontaines and Uslar, who found that the irritability of plants is strongest in the morning, fainter at mid-day, and fainter still in the evening. Sennebier has made the experiment of separating the rays of light, in order to discover which of them is most favourable to vegetation, and he found, that plants of Lettuce grow best in the yellow, and next in the violet. Those on which the invisible ray fell, came nearest to those which stand free in the collected light.

§ 280.

The irritability of the vegetable fibre is destroyed by all stimuli when they are too powerful or too long continued. Every stimulus must be proportioned to the irritability of the fibre; in proof of which may be adduced all subterraneous plants and all the species of Boletus: for the knowledge of which we are indebted to the researches of Scopoli and Humboldt. These plants require a very small quantity of oxygen to promote their growth, and therefore as soon as they are brought into the open air, they decay. This is even proved by the well known observation, that rooms or repositories which are fusty or mouldy, are freed from this inconvenience by the admission of the air.

Opium will destroy the irritability of plants; by it the irritability of Hedysarum *gyrans* and Mimosa *pudica* was greatly impaired, and almost completely destroyed.

Vegetables die very soon in carbonic acid gas; as well as in nitrogen and hydrogen gas. In the last of these, plants die immediately, but if it is mixed with a little oxygen gas, they live for a short while and grow very luxuriantly.

Mr Humboldt on the 14th February 1792 put a germinating bulb of the Crocus *vernus*, which he had planted, into one of the celebrated mines of Freyberg, several fathoms under ground. In this mine the air was so much contaminated with hydrogen gas, that his candle was extinguished, and his lungs became sensibly affected. The germ of the bulb soon evolved, the leaves became green, the flowers yellow, and the anthers even full of pollen; but on the 17th the whole plant suddenly began to putrify. Several plants shewed the same result. The hydrogen gas cannot however be considered as a stimulus of vegetables, as in its pure state it kills plants, and only when mixed with oxygen shews the above phenomena. Plants live so long only, as they can exhale oxygen; when this stops they are gone. In the same manner, Sennebier and Ingenhouss observed that plants confined in Hydrogen gas, emitted oxygen day and night, but that when the oxygen gas was consumed they could no longer subsist.

§ 281.

The above numerous observations are sufficient to prove that vegetable sap is not put in motion by mechanical principles, but that it is carried forward by the irritability peculiar to plants. The ascent of sap in warm weather and the descent of it in cold weather can no longer be argued, but experiments, and the analogy between plants and animals, clearly point out a circulation. For how could the juices of trees, which during winter continue bare, without foliage, and without discovering any symptom of vegetation, be at all preserved, if in the long succession of cold weather, the moisture which is found in the vessels were constantly to descend. We should at last necessarily find the branches quite destitute of fluid, which is never the case. Nor is the cessation of sap, or the congellation of it in very cold weather more admissible. We know from experience that when the juices of delicate exotic plants are coagulated by cold, they must die. The circulation of sap must therefore take place in them, as they cannot, on account of the unfavourable season make new shoots still and survive; and, though much less vigorous, they appear to exist in the same manner as Hybernating animals, such as the marmot, and dormouse, which, during the winter, like amphibious animals and some insects, fall into a profound sleep, and are awakened first with the returning warmth of spring. Experiments have not yet discovered how the circulation of blood in these species of animals adapts itself to the season of the year.

What has been adduced as proof of the ascent and descent of the sap in plants, is the important, but altogether mistaken phenomenon, that after the middle of January, with us after the 20th, the sap enters trees. At this period it is thought to descend, to be ready in the spring. But whoever thinks that trees, shrubs or herbs are dead in winter, or without action, is much mistaken.

During the whole summer the root sends the food, imbibed by its fibres, to the stem, and what the stem receives from the leaves is constantly employed in the formation of new parts, till either this evolution ceases, from the strength being exhausted, as in annual plants, or till the parts above ground, which can no longer resist the inclemency of the weather, become separated, as in herbs, shrubs and trees. With the fall of the leaves in ligneous plants, and with the drying of the stem in herbs, all their vegetating powers are exhausted. The great quantity of moisture which the root forwarded to the plant, is consumed; in trees and shrubs, it is employed in the formation of branches, of wood, alburnum, inner bark, leaves, blossoms and fruit, as well as in the formation of the root: in herbs, in the formation of the parts above ground, the fruit and the root itself. These fibres, which hitherto conveyed the food, begin to become brittle, and are no longer able to serve this purpose. The sap which circulates in the vessels can no longer produce new shoots above ground, as the temperature is unfavourable. From the moment, then, that the leaves of ligneous plants and the stems of herbs decay, the plant begins to form new radicles in place of the old ones. If at this period, in the latter part of autumn till the middle of January in our climates, a birch or walnut is bored, no sap will proceed. The tree indeed has sap, but only as much as it just wants, and as suffices to form new radicles. Hence fruit-trees, which had too much fruit, decay, because their strength by the great waste of sap is too much exhausted. If such a tree or shrub has formed radicles, before the middle of January, those active young radicles perform their new functions. They imbibe moisture, which they deposite in the cellular texture, and collect in this manner as much sap as the wasting of the powers, which will be necessary in the next summer requires. If at this time a stem is bored, a great quantity of fluid flows out, in those plants which receive a superfluity. But if at the end of January, or in February, the weather becomes mild, this flow of sap ceases altogether, and trees, if then bored for the first time, give no sap; a stream of it is observed again when the weather becomes cold. Those who adhere to the theory of ascent and descent of the sap, say, that in warm; weather the sap ascended too high, and in cold descended too low. This singular change, however, of its flowing and ceasing to flow, depends on this, that as soon as the weather is fine and mild, the transpiration of plants goes on with greater rapidity; the quantity of the sap, therefore, naturally becomes less; on the contrary, in cold weather the transpiration is not considerable, and therefore the sap accumulates.

On this account the roots of herbaceous plants which are collected for medicinal purposes, are more efficacious in winter and spring, than in summer, when in full leaf and flower, because, at that time, they have prepared new sap by their young radicles.

§ 282.

The circulation of sap in vegetables, cannot be of the same nature as it is found in quadrupeds, birds, fishes, amphibious animals and insects; else, we should observe a point from which all the fluids proceeded, and where they again meet together. Were there such a circulation, the willow could not reproduce new stems from every little branch.

The circulation of sap, then, must resemble that which takes place in the polypi, as these also may be dissected into several pieces, from each of which new polypi are again formed. The nature of circulation must be extremely various in the different classes of vegetables: Impatiens *Balsamina*, being a meadow plant, whenever it is without water, immediately withers away; but when water is poured upon it, in five minutes after all the leaves and the trunk again stand erect. A tree or shrub will not recover so quickly. I observed a cherry tree, the stalk of which was broken immediately under the top, and in which the top was attached to the stem only by a small stripe of bark. It was immediately fastened;

the buds were just opened, but the flowers were still confined; in about eight days after nothing was observed at the top, it bloomed rather more luxuriantly, but in a short time, all of it decayed. I have observed also in the broken off branches of fruit trees, that the fruit became ripe; and also that fruit trees, the stems of which were frozen, still continued to vegetate, till towards the middle of June; they then decayed. Thus the juice of trees, which is imbibed by the root, appears to be long in reaching the upper part. We must then take for granted, that small coherence by means of the bark in the broken top of the cherry tree, and in the bough of the fruit tree, had, as well as the still living wood of the congealed fruit stem, conveyed out of the root a sufficient quantity of sap for some time. Be that as it may, it is certain that the sap of the root is much longer, or slower in reaching the top of ligneous than of herbaceous plants. A shrub the roots of which are decayed, or consumed by insects, will for a long time have discoloured leaves, and yet live; and will even vegetate some time after its root has been destroyed.

It is highly probable, that the circulation of vegetables is very complex, and Corti (§ 277), may not be far wrong when he ascribes a circulatory system to every knot of plants. We may therefore suppose that the root imbibes the fluids, which on the admission of heat, and the gases produced by it, are formed by the adducent vessels, particularly those that twine round the air vessels, are communicated to the reducent vessels by means of the cellular texture; and are again conveyed into the posterior adducent vessels through the same channels rising by degrees higher and higher till they reach the stalk. Here every knot that evolves a bud, appears to form with the leaves, a circulatory system, which by means of the passing adducent, and reducent vessels, and of the cellular texture, is united to all the other systems, and to the whole plant. According to this principle, I may cut off from the stalk, a small slip, which has only one knot, one bud, and one leaf, and by placing it loose in the ground, render it a plant. As the slip which has its own peculiar circulation, is separated from the common circulating system, it will be for a period in a state of inaction, without evolving any new leaf, but in a short time, the vessels, which exist in this part of the stalk, viz. in the knot, the bud, and the leaf, begin to form a callus below, sending out new parts that become roots; these young roots soon imbibe nourishment, the bud is evolved, and becomes a young plant, in which again several systems of circulation are found connected with the whole. The following observation may serve as a proof that every knot has its circulatory system: If in a young sprout, I cut the knot on which the bud stands, it will not grow, or produce a new plant; neither will a piece of the stalk grow, in which there is no knot with the bud. As far as our observations extend, the circulation of sap cannot be explained in any other manner. That, according to the differently formed plants, there are more or less anomalous circumstances or exceptions, is easy to be supposed.

But of what nature is the circulation of sap in ligneous plants during winter? In all probability, the juices continue to be moved in the same general manner, and to be renovated from the root: their circulation of fluids, however, is slow, because no new parts can be formed in the open air, and because the transpiration is considerably diminished.

§ 283.

The nourishment requisite for vegetables, is not all derived from the soil in which they are planted, the greatest quantity being obtained from the atmosphere. Shrubs, trees, and succulent plants, in particular, receive most of their sustenance from the air: dew, mist, and rain, are also rapidly absorbed by them. The secondary vessels (§ 241), properly perform this function, so do all fine capillary elongations. Thus the green stalk, and the under surface of the leaves, chiefly absorb these moist vapours.

Bonnet demonstrated this last fact by a beautiful experiment. He placed a leaf of the white mulberry tree, (Morus *alba)*, with its upper surface upon water, and it continued six days fresh and green. A leaf of the same tree, which was laid with its under surface upon water, remained for six months fresh, and in good condition.

Plants imbibe gases also, otherwise it would be impossible to explain whence they derive the great quantity of carbon, of which they principally consist.

§ 284.

The function of transpiration is performed by plants through apertures which are surrounded by the lymphatic vessels. Bonnet anointed leaves with oil, by which means the process of transpiration was completely suppressed. They assumed a black colour, and decayed. I observed the same thing in a hot-house plant, the leaves of which being oiled in order to destroy the aphides, all fell off. Plants which have been exposed to the dust, by the continuance of drought, lose the leaves, merely because their pores are obstructed.

The number of the pores which are found on the whole surface of a plant, is by no means insignificant. Hedwig enumerated five hundred and seventy seven in one single quadrate line, on the surface of a leaf of the Lilium *bulbiferum*. Thus, according to this computation, a square foot would have nine hundred ninety-eight thousand, seven hundred and forty-five. How many square feet of surface must a plant present to the air, and how great must be their number in a full grown oak!!

The transpiration of plants is twofold, aqueous and gaseous. The aqueous is considerable; Hales made many experiments, which clearly prove this assertion. A plant 3 feet high, lost in one hour, 1 lb. and 6 oz. during the night: if no dew fell it sustained a loss of six ounces; but if dew fell, the leaves had imbibed 4 or 6 ounces of moisture; whereas in the day time, the transpiration was always very considerable. Watson exposed a glass of 20 square inches within, to very warm sunshine, in a place where it had not rained for several months, and turning it round upon a plot of mowed grass, he found it full of drops of water, which ran copiously down; he collected them by an exactly weighed piece of muslin, and repeated this experiment for several days, between 12 and 3 o'clock; hence he was enabled to calculate that an acre of ground transpires in 24 hours, 6400 quarts of water. Brugmanns observed a particular kind of aqueous transpiration in the roots of some luxuriant plants; he had put some plants of this kind into a glass filled with earth, and observed at night a drop of fluid in the top of the radicles; he remarked as soon as such a drop touched the roots of other plants, they dried immediately. If this happened frequently, the plant decayed.

Thus Oats, (Avena *sativa)*, were destroyed in this manner by Serratula *arvensis.*

Flax, (Linum *usitatissimum)*, by the Scabiosa *arvensis* and Euphorbia *Peplus.*

Wheat, (Triticum *aestivum)*, by Erigeron *acre.*

Buck-Wheat, (Polygonum *Fagopyrum)*, by Spergula *arvensis.*

Carrots, (Daucus *Carota,)* by the Inula *Helenium.* Hence he concludes, that weeds with the fluid dropping from their radicles, suppress the growth of the contiguous plants. But might not the weed destroy the cultivated plant, owing to its absorbing the alimentary matter with greater rapidity, and expanding sooner, and thus prevent the further growth of the adjacent plant?

Drops are also frequently observed on the leaves of quick growing plants, particularly on the top.

The gaseous transpiration of plants was first observed by Bonnet in 1754, after him by Priestley in 1773, and next by Ingenhouss 1779, afterwards by other celebrated philosophers, Sennebier, Scheele, Achard, Scherer, Succou, &c. &c. No branch of the physiology of plants has produced more numerous experiments. The following are the results of all these laborious investigations: Plants in sun-shine emit a great quantity of oxygen gas, but at night exhale a kind of air which is unfavourable to animal respiration. The quantity of this, however, is much less than that of the oxygen lost in the day time. Thus a constant circulation takes place in the atmosphere, the plants improving the air which has been spoiled by the breathing of animals.

The surface of leaves, all green stalks, and in general the green part of vegetables, exhale oxygen gas in sun-shine, but particularly green water plants, pine trees, gramina and many succulent plants.

The leaves of trees emit less of it than herbs. No oxygen gas whatever, even when exposed to the sun, is emitted from Ilex *aquifolium*; Prunus *laurocerasus*; Mimosa *sensitiva*, Acer *foliis variegatis*, the petala, ripe fruits, the bark of trees, the pedicles and the ribs of leaves. The gas which is emitted during night is by far less in quantity, either pure carbonic acid gas, or, as in most cases, often mixed with hydrogen, sometimes also with azote.

§ 285.

Water is the chief nourishment of plants. They absorb it out of the earth by their roots, and above the earth they imbibe all the moisture which exists in the form of vapour. The light by its stimulus resolves water into its constituents, hydrogen and oxygen. The oxygen combines with the caloric, becomes gaseous, and conducted by the air vessels runs out from the pores of the leaves. The hydrogen combines with carbon which plants likewise absorb, and with several elements which the vegetable body receives in various proportions, according to its organization, and forms the juices and other substances peculiar to vegetables.

At night, when the light cannot effect the decomposition of water, combinations and separations of another kind take place, and for this reason plants then discharge carbonic acid and azotic gases. The little oxygen which remains cannot stimulate the fibre so powerfully, consequently the quantity of transpired matter is much less. The stimulus which the oxygen, separated by the light, has exerted upon the fibre, occasions a relaxation, by which the sleep of plants, or folding of the leaves is produced. Light is absolutely necessary to plants, as it nourishes them by means of its influence. If we except subterraneous plants, and some species of Boletus, the vegetation of which is regulated by other principles hitherto not investigated, vegetables cannot exist without the influence of light. The direction, and proper situation of the parts in every species depend entirely upon it.

Plants also, which affect the shade require light, but that only in a moderate quantity; the rays of the sun would stimulate them too violently.

Young plants as well as most of the Cryptogamous class, require defence against too powerful light, but cannot live without its influence.

Trees and the most of the gramina need a great deal of light, and hence all trees have a greater tendency towards the south than towards the north.

It is by the decomposition of water that the temperature peculiar to plants is produced (§ 235.) Philosophers, however, are not entirely agreed in their explanations of this phenomenon. Sennebier and Hassenfratz assert that the oxygen, being set free by the decomposition of water, unites with the caloric of the vegetable fibre, and flows in a gaseous form from the pores of the vessels. Von Humboldt again, supposes that plants absorb caloric from the atmosphere, and combine in the air with the oxygen, which is separated by the influence of light. He believes that in this manner the cooling shade of trees may be accounted for.

The functions of absorption and exhalation appear to take place in mushrooms according to their principles. This, however, needs to be confirmed by future observations. Agaricus *campestris*, and *Androsaceus*, continually exhale hydrogen. Oxygen appears to be a stimulus to them, as the most of them when immersed in hydrogen and azotic gas are soon destroyed.

§ 286.

How the matters which are absorbed by plants are assimilated, that is, are combined into the juices peculiar to the vegetable world, is a mystery to us. In none of the organised bodies have we hitherto been able to explain this assimilation, though there has been no want of theories upon the subject.

Some account for this beautiful operation by mere contraction of the parts; others by the form of the active organs; others again by the form of the substances; but these are all very unsatisfactory hypotheses. This much, in the mean time, appears certain, that the proportion of the parts, as well as the formation and direction of the organs, and the greater or less irritability arising from them, may produce the various mixtures. But how comes it to pass, that every part of a plant frequently differs in taste and in smell? Thus the root of the Mimosa *Nilotica* smells like assafoetida, but the flower emits a very agreeable odour. The stem exudes the bland well known gum arabic, and the juices which it contains are sour and astringent.

It would appear that plants first form out of the elements, the constituents which are found in them, and do not obtain them in such a state from the earth. Even the earth and metals which are found in them appear to be originally formed out of the elements by the power of the organs. Schrader has made some very interesting experiments on this subject, He sowed in sublimated sulphur several species of corn, sprinkled them with distilled water, and prevented dust or any other foreign body from approaching them; in this way no earth could come upon them; and yet these species of corn had the same constituents, the same kinds of earth, and metal, viz. iron and manganese, that are found in the culm and ears of those which grow in the usual manner*.

Some philosophers maintain, that plants imbibe from the ground earthy, saline, mucilaginous and oily substances, and again deposit them. They therefore imagine that manure gives to vegetables the constituent parts, and that on this account plants grow up in it with greater beauty and rapidity. But plants do not deposit crude juices, which have not been wrought in the cellular texture (§ 241), on the contrary, all the fluids are completely formed. Were the case otherwise, a great quantity of Ammonia, Phosphorus and other constituents discovered in animal excrements, would be found in plants reared in dung. Now in corn growing in a soil, either plentifully manured or not manured at all, a greater or less quantity of these constituents is never observed.

* I need here only advert to the experiments made on young chickens which are gently withdrawn from the egg, and as yet receive no nourishment. It is found that the chicken contains five times more lime than the egg before being hatched. In this case the lime must be formed first out of the elements by organised power, or is any other way imaginable by which it could find its way into the young animal?

Manure operates only as a stimulus on the fibre of vegetables, so that they are enabled to absorb carbon the more rapidly, and all the constituents are first composed. This is particularly evident from the above related experiments (§ 278), where delved earth, saturated with oxygen, as well as ground sprinkled with diluted sulphuric acid, made plants grow more rapidly, than a great deal of manure laid upon the earth.

§ 287.

The vessels appear particularly to prepare the juices, as fluids have been found completely prepared in the cellular texture of the root. It seems, however, as if the receptacle of the manures in the cellular texture concentrated them still more; and that this also contributes its effect to their preparation. Thus as glands prepare in general oily, seldom mucilaginous fluids, a great quantity of glands is therefore found in the leaves of all fragrant plants.

Sometimes this oil abounds so plentifully in the glands that it may be separated from them by mere pressure; as in the rind of Citrus *medica*, *Aurantium*, &c. and in the leaves of Melaleuca *Leucodendron*.

Vessels which are still young, are the most active in plants. As soon as they begin to pass into alburnum or wood, the circulation of their fluids is in a sensible degree slower.

Thus the chief seat of life, particularly in ligneous plants, is to be sought for in the inner bark. Hence trees become strong and large when they receive no external wound on the stem, so as to injure the inner bark. Trees, the bark of which was frozen in severe winters, will decay, whereas those which lose their pith by cold, without their inner bark being affected, may continue to grow without sustaining any injury.

Where the layer of the inner bark, which as we know is composed of vessels, is thinnest, the growth is most rapid, and leaves are also formed. For this reason, thin branches are provided only with leaves.

The inner bark begins in the alburnum, *i. e.* there are new vessels situated in the alburnum, which as long as they form a thin delicate layer easily separable, are called inner bark. This layer, however, hardens into alburnum, and at last into wood. Du Hamel saw no connection between the cortex and wood of a willow tree. He found, however, a moisture, which in the air became mucilaginous and tenacious; this he with Grew called Cambium. He alledges that it is the formative organ in plants. He took away from a cherry tree in full bloom all its cortex longitudinally, and covered it closely with a layer of straw; many of the leaves fell off, some of the branches withered, and no fruit was produced. The tree continued diseased next year, but in the third summer, it again acquired bark.

Had the young wood, deprived of the stem which is full of moisture, and which had lately, for the first time, formed the new layer of inner bark, not been preserved from the access of the air, the juice would have dried up, and the tree been destroyed; but the covering of straw inclosed it as well as the cortex, and it again formed the same layer of inner bark with the cortex.

The hardened fibres of vegetables, comprehended under the general name of wood, have, however, different degrees of hardness in proportion as they confine carbon by the power of their organization, and the harder the wood proves, the slower is the growth of the tree or shrub. The firmest and hardest woods have, therefore, the most carbon, and require a long time for their perfect vegetation; as, the white beech, (Carpinus *Betulus)*, the red beech, (Fagus *sylvatica*), the oak (Quercus *Robur* and *Pedunculata*), the cedar of Lebanon, (Pinus *Cedrus*), Adansonia *digitata*, &c. &c. There are, however, exceptions to this rule, as Robinia *Pseudacacia*, which grows very fast, and has firm hard wood.

Every shrub or tree with us, forms annually two shoots, the one, which is the chief shoot, evolves in spring, the other is not so strong, and appears towards the longest day, about St Johns' day, from which it has been called St John's shoot. The first is formed from the quantity of juices which the root has imbibed during winter. The second, from the moisture imbibed during the spring. In the torrid zone, both shoots are equally strong, and hence plants there grow much more luxuriantly.

§ 288.

The green colour of the vegetable creation is a most refreshing sight. The investigation of its cause has long occupied the attention of philosophers, and given rise to many hypotheses. When phlogiston still had a number of adherents, the explanation of the green colour was very easy, as it was considered as an effect of this principle. Since, however, the idea of its existence has been given up, different kinds of explanation have been devised. Berthollet observed, that the green of plants is not composed of blue and yellow, as the prism does not analize their green, like that of other bodies, into yellow and blue rays.

After extracting with alcohol the green colour from the leaves, and exposing this mixture to the sun or atmosphere, the green colour disappears entirely. The oxygen of the atmosphere combines with the mixture, and banishes the colour. If a solution of ammonia, which consists of hydrogen and azote, be dropped into it, the latter separates the oxygen from the mixture, and the green colour is restored to it. From all the observations on this point it follows, that leaves, from which the oxygen has been withdrawn by means of light, are green, but have a pale or whitish colour where the oxygen is accumulated. The mixture of hydrogen and carbon is now considered by chemists as the cause of the green vegetable colour.

§ 289.

The dark colour of the cortex in woody plants is, according to Berthollet's observations, produced by the oxygen of the atmosphere. Mr Humboldt repeated his experiments, and found that wood, when enclosed in oxygen gas, became black in two or three days, and the gas was mixed with carbon. It appears from this, that the oxygen of the atmosphere combines with the hydrogen of the vegetable fibre, and sets the carbon free, which shows its particular black colour.

§ 290.

The leaves of plants are of various duration. Most of them in warm climates remain from three to six years on the branches. A few in colder climates, and only those which have a tenacious sap, as Ilex *aquifolium* and Viscum *album*, or such, which have sap of a resinous nature, as all the pine-tribe trees, retain their leaves during winter. All other plants of the colder climates drop their leaves in autumn. This happens in many different ways. Some leaves decay gradually, and fall off, or remain on the stem in a dry state till spring; others fall off when still green, even in the mild, serene days of autumn. In quite a different manner the Robinia *Pseudacacia* parts with its leaves. The pinnate leaves of this tree first drop, then all the pinnulae, and at last, after them, the petiole to which they adhered drops off.

Various reasons have been given why plants lose their leaves in autumn; the principal opinions of philosophers on this subject are the following:

Du Hamel formed two hypotheses about this phenomenon. He assumed, in the first, a herbaceous part in the petiole, at the spot where its notch is, which in cold autumnal nights is injured, and produces the falling off of the leaves.

He abandoned, however, this opinion, because he saw leaves drop off in warm autumnal days, without any preceding cold, and then devised the following explanation. The moisture, which is conveyed by the root, favours the growth of the petiole, the great transpiration of the leaves renders it at last quite dry, and therefore the leaves fall off, because the petiole has lost all its sap.

Mr Mustel thought that the leaves transpire less during autumn. Hence the sap is accumulated in them, which produces a transverse fissure at their basis. The leaves, therefore, must separate from the petiole, and drop off.

Vrolick supposes that leaves possess a peculiar life, in which various periods may be perceived. Their life, however, depends entirely on the life of the plant. When they fall off, they have come to their greatest age, and the plant can exist for some time without them. The dead leaves separate from the living part, like dead parts in the animal economy from sound ones.

Were the opinions of Du Hamel and Mustel founded in truth, the leaves would never fall off in warm climates. But there are in the East Indies some trees which, at the rainy season, drop all their leaves, and, like our trees, are perfectly leafless. Mr Thunberg likewise saw at Java an oak tree which lost its leaves at the same time as in Europe. There must, therefore, be another cause of this phenomenon. Vrolick's opinion is just, and perfectly corresponds with all observations.

The true cause of the falling off of the leaves is this: During the summer, the vessels of the petiole become gradually ligneous, as the sap is conveyed to them in greater quantity, and the whole frame of the leaves gets a more ligneous consistence. The sap must in consequence gradually stagnate, and at last the communicating substances between the stem and the petiole are completely shrunk. The wound which the stem thus receives cicatrises before the petiole separates. The connexion now interrupted between the leaf and the stem, and their vessels, causes the petiole, by which they are connected, to separate entirely, and thus, especially in calm serene weather, the leaves unavoidably fall off. For as the rays of the sun still favour the last decomposition of the water, and the reducent vessels cannot convey the small quantity of moisture to the knot of the petiole, the motion of the small quantity of sap naturally remaining will cause some sort of concussion, which is sufficient to occasion the fall of the leaf.

In the oak-tree the leaf cannot fall off in autumn, as the vascular fibre of this tree is very tenacious, and on this account the connexion between the knot of the petiole and the stem is not broken. In the Robinia *Pseudacacia* the small and tender petioles of the leaves first are closed up, and separate of course earlier from the common petiole, which is still succulent enough to remain a short time, but soon, as without the leaves it cannot subsist, has the same fate. It depends, therefore, entirely on the nature of the leaf, how long it is to remain on the stem, and by no means on the weather. The peculiar organization must not be overlooked, as it really has a powerful influence.

§ 291.

The growth of the plant ends with the evolution of the flower. When a plant has acquired a certain degree of firmness, (which, as they are so multifarious, does not happen in each at the same time, or in the same age), it then becomes capable of propagating its own species, and that part which we call the flower, is now formed. Its speedy appearance in herbaceous plants, may generally be observed from the circumstance, that the minute scaly leaves grow gradually less, till the smaller and more delicate parts of the flower are at last unfolded. Goethe is therefore not mistaken, when he calls the growth of plants a contraction and expansion; an idea which Wolfe already has endeavoured to prove.

§ 292.

The flower is, as all the other parts of plants, formed by spiral vessels, which, as soon as the first rude sketch, as it were, of the flower exists, are already observable. Linné formed a very erroneous idea of this subject. He considered the pith of a plant, which he believed to be of equal importance with the spinal marrow of animals, as the sole formative organ in the whole vegetable kingdom. Vegetation in general, according to his opinion, went on by means of the pith. The seed itself was a small piece of pith, which separated from the mother plant, on purpose to go through the same revolutions as the old plant had done. But he proceeded still farther, and ascribed to each part of a plant a certain peculiar power in forming one part of the flower. The calyx was formed by the bark, the corolla by the inner bark; the stamens were formed by the wood, and the pistils by the pith. He carried this ingenious hypothesis still further, by asserting, that in ligneous plants each branch required five years for the final evolution of the flower, and that each year something was added to the future flower. In the first year, for instance, the scales *(squamae)* are formed, when the branch is shooting out from the bud; in the second year the calyx; the corolla in the third; in the fourth the stamens; and in the fifth the whole, for the formation of which nature required all that time, is completely evolved.

Linnaeus may be right so far, that plants require a certain time to blossom; that in them previously a great quantity of sap, which has been so carefully elaborated, as to become capable of forming parts so important for the continuation of the species, is first laid up; but that every year any one part of the flower, as an effort, is produced, would be very difficult to prove. As little can we suppose that the pith alone is the only formative part in plants. It is clear from the account of its use and design, (§ 272), that it may be wanted, which is contrary to the old opinion. But that the cortex, inner bark, wood, and pith, &c. should each form a peculiar part of the plant, is so much against common experience, that it is hardly necessary to refute it. We find in the springing flower, elongations of spiral vessels, but we never see elongations from each particular part, one forming the future calyx another the corolla, and so forth. For instance, in the common sun-flower, (Helianthus *annuus)*, where on a large receptacle, numerous small flowers are placed, how should those elongations be able to unfold themselves into florets from the bark, inner bark, &c. through such a receptacle? There would arise a confusion amongst those small parts which is never met with. Further, how should the stamina be produced in herbs, which are not ligneous, or the pistil, in plants which have no pith? Who does not see that all these assertions are mere hypotheses, which may be refuted, even without the aid of anatomical investigation?

The flower does not always appear in the angles of the leaves or at the extremities of the stem, but in some plants it shoots forth in very uncommon places.

Rohria *petioliflora* has its flowers situated on the petiole. This is also the case in Salsola *altissima*, and some other plants. In most species of the genus Ruscus, the flower is found in the middle of the leaf. Most species of Phyllanthus, Xylophylla, Polycardia, and one species of Ruscus, R. *androgynus*, flower on the margin of the leaves. On branches which are leafless appear the flowers of Cynometra *ramiflora*; Ceratonia *Siliqua*; Averrhoa *Bilimbi*, and A. *Carambola*, Boehmeria *ramiflora*, and other plants.

Most remarkable is the station of the flower in a tree of the East Indies, called Cynometra *cauliflora*. This very leafy tree has no flowers, but at the foot of its stem; its leafy top never produces any.

§ 293.

The flower, (§ 71), consists of the calyx, corolla nectary, stamens, and pistils.

The calyx and corolla are, in point of the distribution of their vessels, exactly like the leaves. The calyx, when green, transpires, like the leaves, oxygen gas in sunshine; but when it is coloured this does not take place. Both these parts imbibe their necessary support from the air, and convey it to the receptacle on which the flower is placed.

The functions of absorption and transpiration are performed by the leafy parts of the flower as well as by the leaves of the plants. Only the coloured flower emits other gases. Hitherto it has not been determined, whether the phenomenon which the Dictamnus *albus* presents in warm serene summer nights, when there is no moonshine, is produced by hydrogen gas, or by the transpiration of a fine volatile oil. If this blooming plant is in abundance, and about this time is moved suddenly through an extended space, and if immediately adjoining there be a piece of burning paper, a fine blue flame which may be easily extinguished, is instantly emitted. The daughter of Linnaeus observed in the Tropaeolum *majus*, and other flowers of a deep orange colour, an electric spark, during the dark and serene warm summer evenings. The nectaries, (§ 86) when they do not consist of mere glands, agree in structure with the corolla.

§ 294.

The stamens (§ 90), consist of the filament and anther. They are likewise called the male organs of generation. The filament, in the distribution of its vessels, sometimes resembles the herbaceous stem, sometimes the leaves, according to the variety of its shape, which differs very much, but in each plant commonly bears a peculiar and constant character. The anthers are formed of a thin but vascular membrane, filled with pollen.

The pollen occurs under a variety of forms, which can be seen only with a microscope. Jussieu, Du Hamel, Needham, Gleichen, and others, observed with a high magnifying microscope, that the grains of the pollen, when brought in contact with water, burst with a degree of violence, and emit a gelatinous mass. Koelreuter, on the contrary, assures us, that ripe pollen does not burst suddenly when wetted, but slowly emits through its pores, or, if provided with small prickles, through those an oily fluid, which on the surface of water forms a distinct shining pellicle. He says further, that each single granule of the pollen consists of two membranes; an external one, which is thick, elastic, cartilaginous, and full of very delicate vessels, in which last are the pores which emit the oily liquid, and secondly an internal very fine membrane. The internal surface is lined with very tender, elastic, cellular texture, which contains the oily impregnating mass. Hedwig, however, after his latest researches, does not agree with Koelreuter. He says, that each granule of the pollen consists of one vascular membrane only, filled in its interior with a gelatinous mass, but has no cellular texture whatever. And, according to him, the pollen emits this fluid at once; it does not exude out through pores. Hedwig examined that portion of pollen, which had on the female stigma performed its functions, and he found this observation confirmed. Even the stamens of the mosses are, according to him, only granules of pollen acting as the others. He finds a great similarity between this fructifying mass and the semen of animals; only, that as well as in the animal kingdom, it differs in consistence in different species. Most observations indeed coincide in this, that the moisture which is contained in the pollen, is not oil, but a mere gelatinous mass, which, however, cannot easily be mixed with water. It is, however, likewise proved by experience, that this mucus contains a considerable quantity of oil, for an oil may be obtained from the pollen by pressure, as it takes fire when thrown into a flame, and finally, bees prepare their wax from it. It does not however follow, that the whole is oily; for an almond cannot be called merely an oily substance because oil may be obtained from it; it contains this oil in a gelatinous mass.

As in the animal kingdom, a more important question, what constitutes the impregnating power of the pollen, or on what does it depend? remains still unanswered. Is it a subtile oily vapour, or a subtile volatile aura? or is it, according to others, electricity, or any other power? Still we are here in the dark.

§ 295.

The female organs of fructification are the pistil, (§ 94), which consists of the germen, the style, and the stigma. The germen varies in its shape and structure in various plants. It is composed of all those vessels which we noticed in the rest of the plant; their direction and distribution only differ in each. The seeds, if the germen itself does not become a seed, are situated in it, and are connected with it by the umbilical cord, (§ 116.) In its interior, it contains a clear fluid, in which nothing particular can be perceived. When the germen is converted into a seed, the umbilical cord hangs together with the receptacle, and is very short. The internal structure of such a germen, is the same as that of the seed which is contained in the germen.

The style (§ 96,) appears under a great variety of shapes. All the known vegetable vessels compose it, and it has hollow tubes, which at the top are, by a tender cellular texture, connected with the surface of the germen, and with the cord of the seed.

Hedwig, in his microscopical researches, found in the species of gourd, *(cucurbita)* and its kindred plants, on the stigma, hollow channels, in which he detected a firm, yellow, gelatinous body, which in the gourd was quadrangular, ran through the whole extent of the style, and ended in the umbilical cord of the seed. It appeared impenetrable, and incapable of carrying any fluid. But as, unquestionably, it contributes to the fecundation of the pollen, either as a conductor or as a conveying medium, he calls it *conductor fructificationis.* Its use, however, is yet concealed from us; and it is even not yet precisely ascertained, whether other plants have it, or if a different regulation in them answers the same purpose.

The stigma consists of hollow absorbent channels, the structure of which is observable only with the microscope. Those absorbent channels or tubes constitute the stigma. What the Terminology calls stigma, (§ 97,) is not always stigma, and sometimes a very small part of it; at other times, the whole style is stigma.

The pappus, which is met with in compound flowers, (§ 117), and which exists completely formed in the ripe seeds, is certainly not to be considered, with Rafn, as a mere inorganic lifeless fibre. To me, it appears to consist of large elongations of the secondary vessels, which contribute a great deal to the condensation and proper preparation of the sap. They, indeed, grow themselves at the very period they perform these functions; when, therefore the seed has attained its proper size, the vessels of the pappus become plugged up, and it remains dry upon the seed.

§ 296.

The stigma, now in its state of puberty, or when fit for impregnation, is covered with a fluid, which Koelreuter likewise considers as oily, but the nature of which is yet not investigated. The period when the stigma is moist and the anthers burst, is the period of impregnation. This copulation, however, is in plants performed in so very striking a manner, that we cannot contemplate without admiration the wise measures which nature has taken for the accomplishment of her designs. Most flowers are hermaphrodite, or such as have both male and female organs of generation; and one would from this circumstance be led to believe, that in such flowers impregnation is readily completed; this however is not the case with all.

Mr Sprengel has made many observations on this point, most of which are highly important. He discovered two principal ways in which seeds are impregnated, to wit, Dichogamy, (*Dichogamia*), and Homogamy, (*Homogamia*). He calls it Dichogamy, when in a hermaphrodite flower one organ of generation is first evolved, and when this has lost its generative power, the other organ arrives at perfection. This is again of a twofold kind. Either the male parts are formed perfectly, before the female parts unfold themselves, which he calls Dichogamia *androgyna*; or it is the reverse, the female parts being first formed. This he styles Dichogamia *gynandra*. Homogamy is, when both parts of generation are formed in a hermaphrodite flower, exactly at the same period.

Now, in a hermaphrodite flower, when Dichogamy takes place, impregnation cannot naturally happen without intermediate means, by which both organs of generation may be brought near each other. Linné thought that the wind performed this, but there are few plants where wind could do it, as most flowers have such a shape as would rather impede than favour the access of the wind. Koelreuter was the first who observed clearly that many insects serve this purpose, and Mr Sprengel had leisure and patience enough to examine in the flower the manner in which insects proceed in completing the impregnation of plants.

He found that various species of bees, as well as many of the flying insects, are selected by nature for this purpose; and he even observed, that some flowers had their peculiar insects, which alone visited them. His observations on this subject are very numerous. Those insects, it is true, do not visit the flower on purpose to impregnate it, they only seek after the sweet juice which exudes from it in their nectaries. Their hairy body, which nature did not bestow without design, is covered with the pollen, and, whenever they visit another flower of the same species, the pollen is rubbed against the stigma, and impregnation is the consequence. And every insect that is not limited to one sort of flower, but visits many indiscriminately, will, during a whole day, remain with the species on which it first fixed in the morning, and not touch another, provided there be enough of the first species.

Those flowers only which secrete a sweet juice, are visited by insects. Several of these flowers have one or more coloured spots, which Mr Sprengel calls *Maculae indicantes*, as they always indicate that a plant exudes honey, and, as he believes, attracts them. In flowers the hairs are always placed so as to prevent the rain from dropping in, and not to allow the insect to enter the flower at that place, on purpose that it may be obliged to make its way across the stamens. The filiform and leaf-like appendages, which we enumerated amongst the parts of flowers, (§ 89), and which defend the honey, serve the same purpose. But it would be too prolix to give a more detailed account of the manner in which insects do this, as any one has access to see and observe this, if in the least acquainted with the structure of flowers. We need only look at the Iris *germanica*, at many flowers of the class Didynamia, at the Symphytum *officinale*, and many other plants, in order to form a clear idea of it. One of the most singular ways of the fecundation of plants through insects, we have in the Aristolochia *Clematitis*, which I shall describe. Fig. 271 represents this flower on a small scale; it has a linguiform corol, which at its inferior part is spherical, towards the top it becomes long and tabular, and its margins end in a flat and spear-pointed manner. The pistil is placed in the round cavity of the corol, the germen of which is surrounded by six anthers, which are shorter than the germen itself. The germen has no style, but is provided with a hexagonal stigma, which is very shallow, and on its upper surface has imbibing pores. The anther cannot empty the pollen upon the stigma, as the flower stands always straight upright during the period of flowering. The pollen therefore must necessarily fall to the bottom of the flower without being used, if no insects come near the flower. And indeed if it be tried, and all insects kept from the flower by a thin, but firmly closed piece of gauze, no seeds will be formed. It happens indeed not unfrequently, that as it is a particular insect which impregnates the flowers, when it is wanting or not able to find the flower, this last withers without having a single seed. This insect is the Tipula *pennicornis*. The round bottom of the flower is, in its interior, quite smooth, but the tube is lined with dense hair, every one of which is turned towards the interior, so as to form a kind of funnel, through which the insect may very easily enter, but as on its return all the hairs oppose it, it cannot come out. Several insects creep in through the aperture, but are obliged to remain in the cavity of the corolla. Uneasy to be confined in so small a space, they creep constantly to and fro, and so deposit the pollen on the stigma. After this is done, the flower sinks, the hair, which obstructed the passage, shrinks and adheres closely to the sides of the flower; by which means the small confined gnats get free and may now accomplish their farther destination. Who but must admire the wise provision of nature in fecundating this seemingly trifling flower! Other instances of this kind could be mentioned. The dichogamic plants can be in no other way fecundated than by insects. Many flowers blossom in succession on one plant, and the restless insect, which flies from one flower to another, carries the pollen to them all. Epilobium *angustifolium* may serve as an instance of male Dichogamy, and Euphorbia *Cyparissias* as an instance of female Dichogamy. Homogamic flowers, that is, such flowers as have their male and female organs of generation formed at the same time, are mostly impregnated by themselves. Several, however, are visited by insects, which complete what perhaps was not completed in the usual way, or what rain, wind, or unfavourable weather interrupted at the proper period.

In these flowers, the following arrangement is made: When the stamens are larger than the pistil, the flower stands upright, and the stamens incline themselves over the pistil; or it lies horizontally, and the stamens curve themselves archways toward the style, so as to become of the same length with the pistil. Of the first kind the Parnassia *palustris* is an instance. In it the stamens, five in number, recline all over the pistil in the following order: First, one of the stamens places itself across the stigma, lets its pollen go, then rises up and resumes its former position. In the mean time the second is already following in the same manner, and as soon as the first rises from the stigma, the other covers it; the third succeeds like the two first, but as soon as it has risen, the two last come both at once. To the second kind belong the horse chesnut, (Aesculus *Hippocastanum*), and others.

But if in homogamic flowers the stamens are shorter than the pistil, the flower is pendulous, so that the pollen, when falling off, may be enabled to perform its functions. Rarely have such flowers an oblique or horizontal position, and in this case the style turns backwards, to reach the stamens. Some pendulous flowers, however, can be fecundated only by insects, as their stigma is so situated that the pollen does not directly fall upon it; but then these flowers have, as mentioned before, hair or other processes, which oblige the insect to enter them along the stigma; so that, when they return or visit the flower repeatedly, they must rub the pollen against the stigma.

Such plants as are of different sexes and on one stem have both female and male flowers, are mostly impregnated by insects alone. Only those impregnate themselves, which have no nectaries, and where the male flowers stand close to the female flowers, as in some species of gramina; Typha; Coix; Carex, and others. In that case such flowers have their female flowers situated lower than the male flowers, and their petals are very minutely or very deeply divided, so that the pollen when falling, can reach them. This is the case, for instance, with the different species of Pinus and similar trees. Here probably the wind too is of some service. It disperses the pollen in the air, so as often to involve the tree in a kind of cloud. The sulphur rain, as it has been called, which falls sometimes in spring, after thunder storms, proceeds from the pollen of the Pinus *sylvestris.*

Such plants as have on one stem male flowers only, on another female flowers alone, are all provided with nectaries, and the male flowers are larger and more obvious than the female, to allow more readily the insects to carry the pollen to the female plant.

The Valisneria *spiralis*, a water-plant of Italy, is of different sexes; in this the male flower part with the stem, and swims upon the water, that the aquatic animals may the sooner carry its pollen to the female plant.

Many foreign plants flower with us, having distinctly formed hermaphrodite flowers, but notwithstanding bear no seeds. The climate, however, is not always the cause of their barrenness, but the want of insects, which nature destined in their native countries to fecundate their seeds, and which we have not, along with the transplanted, received into our gardens. One experiment will confirm the truth of this observation: The Abroma *augusta* flowered for many years here, in a hot-house, where no insects had access, without ever bearing a single fruit. The gardener tried the experiment to put the pollen, by means of a hair brush, upon the stigma of several flowers, and he got perfectly formed fruit, which again gave him new plants. In many other cases this has been done, which the limits of this work will not permit us to mention. Might it not be adviseable for gardeners, who wish to make cherry-trees or other fruit-trees bear very early in the season, when they often get little or no fruit at all, to place a bee-hive with bees in the hot-house, and at the same time, to take care to let these busy insects get as many flowers as possible?

§ 297.

Nature seems to have given a high degree of irritability to some plants, merely to promote generation. Berberis *vulgaris* has very irritable stamens, for if they are bent only a little, they instantly rebound back to the pistil. Dr Smith found that a small part of them only is possessed of this irritability. Cactus *tuna* has likewise a great deal of irritability in its stamens. If they are touched with a quill, they all incline over the pistil. As soon, therefore, as insects touch these irritable spots in those plants, the irritability exerts itself, and stimulates the parts, and produces generation. Several plants have these kinds of stamens, for instance the whole family of Asclepias, &c.

The elasticity of the stamens also must in some plants produce generation, for instance, in Lopezia; Urtica; Parietaria; Medicago; Kalmia; and others.

The style of some flowers seems to possess some degree of irritability, as it follows the stamens with its stigma.

The shutting and opening of flowers called their Vigiliae (§ 7), do not belong to this subject, though by the way they may contribute something to promote generation. It would appear that light stimulates these parts, and produces an expansion. For this reason perhaps, most flowers open in sunshine. Portulaca *oleracea*, and Drosera *rotundifolia*, are very powerfully stimulated, and therefore open about 12 o'clock mid-day; but this violent stimulus relaxes their fibres so much earlier, and they shut in an hour after. The stimulus of day light appears to be too powerful for Oenothera *biennis*, and it cannot open till free from the influence of strong light. It remains open during the night, from evening till morning, and if the succeeding day is cool and cloudy, it will not close its flowers at all.

The fibre of some flowers, seems to act like a hygrometer, in such a manner that the flower opens by means of moisture, and shuts in a dry atmosphere. This is observed in all the species of Carlina. But is it the too powerful stimulus of the light of the sun, which occasions Nymphaea *alba*, to close in the evening, and during the night to continue immersed in the water?

Light appears also to operate on the separation of the fine fragrant matter of flowers, so that in some, this matter is separated merely by heat and light, in others, by heat alone, and rendered perceptible to our organs of smell.

§ 298.

It is requisite for the performance of generation, that the stigma be moist, and the anthers covered with pollen (§ 296), if there is any medium which prevents both, it cannot take place. Water does not combine with the pollen, and therefore the rain washes it away; most flowers have such a direction, that they cannot easily be affected by rain, but notwithstanding that we see that a long continuance of rainy weather may frustrate the harvest of corn and fruit.

On this account, almost all aquatic plants that are provided with visible blossoms, raise their flowers above the surface of the water, and after the blossoming, the unripe fruit sinks down. Only those water plants, which belong to the cryptogamous class, and some few, such as Najas, Caulinia, Ceratophyllum, which have mucilaginous pollen apparently capable of combining with water, evolve their flowers under its surface; it even would seem that the macilaginous pollen of the Asclepiades, and Orchides, perhaps suffers from water.

§ 299.

Koelreuter examined, in a very laborious manner, how many grains of pollen might be required for a complete impregnation. His chief discoveries on this point are as follow:

All the anthers of Hibiscus *syriacus* contained 4863 grains of pollen, no more than 50 or 60 of which were necessary to a complete impregnation. But whenever he took less than 50 grains, the seeds did not all ripen, but those which were formed, were perfect. Ten granules were the least he could take in this flower, as less would not suffice for it. The Mirabilis *Jalapa* had 293 globules of pollen in one flower, Mirabilis *longiflora* 321. And in each of the two plants, only 2 or 3 globules were sufficient for impregnation. The seed did not appear more perfect, though many more grains were put upon the stigma.

To ascertain whether, in flowers with several styles, each must be impregnated separately, Koelreuter in several of them cut all off but one, and the fecundation was as perfect as could be expected with all the styles. Even in flowers, in which the style was entirely separated, fecundation took place through one of them. This experiment shows, that the tubes of one style communicate with all the rest, and that more styles and more pollen are formed, merely to ensure their determination. From this circumstance philosophers have concluded, that the cellular texture of all germens fixed in the receptacle, must have some general connection.

§ 300.

The great and wonderful process of generation has led various philosophers to form very peculiar hypotheses, which each has tried to establish by a number of arguments.

To give an accurate account of all of them, would be transgressing the bounds of our present researches; it will suffice to mention only the most important. The first natural philosophers thought, that an accidental mixture of solid and liquid parts was sufficient to form, according to circumstances, animals or plants This was called *Generatio aequivoca.* Others imagined, that the small animals which were observed in the semen, *(animalcula spermatica)*, go into the ovaries of the mother, and thus form the future being. Others again, believed that in the mother a rudiment of the future animal pre-existed, to which the semen of the male imparted life. However, this theory was called the system of pre-formation, or the *Systema praeformationis, praedelineationis*, or the theory of evolution. Those three appellations properly denoted three different ideas; but in reality they all concur in this one point, that all three suppose a pre-existence of the future being in the mother. Lastly, philosophers alleged, that the fecundating fluids both of female and male become mixed together, and thus give existence to the future animal. This theory was styled, *Epigenesis.*

The *generatio aequivoca,* was supposed in former times chiefly to take place in insects, worms and plants, but it is now entirely abandoned by all rational men. Harvey's doctrine is now well known, *omne vivum ex ovo*; farther observations of philosophers daily confirm this truth, by new important observations. I would indeed no longer notice this old theory, did not some botanists explain the formation of Fungi, merely by the fermentation of putrifying vegetable matter; their sudden rise, and the places which some of them always occupy, led them to form this idea.

Though Patrin, and some later philosophers, suppose, that the last members of the organized body may, like the species of Boletus, and the intestinal worms, have their origin from generatio *aequivoca*; I must confess that their hypothesis, notwithstanding its ingenuity, never appeared to me sufficiently plain.

The theory of animalcula in the semen of animals being carried over to the ovarium of the mother, where the new animal is formed, has Leuwenhoeck for its author. Some in the vegetable kingdom, assumed pre-existing germs or corcles in the pollen, which in the mother's ovaries, formed the future plant. The most zealous supporter of this opinion was Mr Gleichen. Some even went so far as to see, under the microsccpe, small asses in the semen of an ass, and small lime trees in the pollen of a lime. Strange things may be seen, if persons are disposed to see them. Koelreuter's observations, which we shall notice in the sequel, at once overthrows this doctrine.

The system of pre-formation, which in former times was generally admitted, is now even by its most zealous admirers, much doubted in the vegetable kingdom. Spallanzani, who in animals, by means of tedious experiments, attempted to prove the pre-existence of the animal, before the impregnation of the ovum in the ovaries, freely confesses, that there is no pre-existence of plants like that in animals.

The *Epigenesis,* or generation by a commixture of the fluids given out both by male and female, is what most physiologists now assume as the only true theory of generation both in the animal and vegetable kingdoms. Koelreuter confirmed it by numerous experiments, of which we shall mention one only: He planted the Nicotiana *rustica* and *paniculata.* The first he deprived of all its stamens, and fecundated its pistil with pollen of the last species. Necotiana *rustica* has egg-shaped leaves, and a short, greenish yellow corol. Nicotiana *paniculata,* a stem half as long again as the former, and roundish, cordate leaves, and much longer, yellowish green corols. The bastard offspring of both, kept in all its parts the middle betwixt the two species. He tried the same with more plants, and the result accorded perfectly with the first.

Were we therefore to admit the *animalcula seminalia,* the hybrids could necessarily not have differed in their form from the male plant; and, on the other hand, were the system of evolution founded in nature, they would have the same form as the female plant. The hybrid, however, was intermediate between both; it therefore certainly adopted some parts both from father and mother, and was formed by Epigenesis.

§ 301.

Koelreuter, could anly obtain hybrids by intermixing similar plants. Dissimilar plants never produced them, even though, according to our system, they belonged to one genus. It appears by this, that nature seeks to avoid unnatural mixtures.

The instance of mules not generating, as it was once believed at least, induced many philosophers to make it an axiom, that hybrids are barren. But we now know a good many instances in Zoology of hybrids being very productive, and even the instance of mules does not prove any thing, as in warm climates they are sometimes prolific.

Koelreuter likewise found hybrids of various species of tobacco and some more plants to be sterile, the pistil in them being perfect, but the stamens not completely formed. But there are now several instances of hybrid plants which retain their original form, and propogate themselves. I shall mention a few with their parents:

Sorbus *hybrida.* The mother was Sorbus *aucuparia;* the father, Crataegus *Aria.*

Rhamnus *hybridus.* The mother was Rhamnus *alpinus;* the father, Rhamnus *Alaternus.*

What mixtures do not the species of Pelargonium produce in our gardens? All plants of the 21st, 22d, and 23d classes of Linné mostly generate prolific hybrids. Linné wrote a particular treatise on hybrids, in which he attempted to explain the origin of some particular plants; but unfortunately he has given nothing but conjectures, for none of his observations accord with experience.

Should it not, from the observations made with regard to the hybrids of the animal and vegetable world, be laid down as a rule, with some exceptions, that all hybrids are productive, but that some only want a warm climate, to unfold the male semen? I do not attempt to establish this rule as a certain truth; I rather wish, that philosophers would consider this subject more accurately, and attend more to the hybrids of different climates, in order to discover the truth.

But Koelreuter made some experiments, which afford the clearest proof of the doctrine of *Epigenesis* and the fructification of plants. I shall only mention one of his observations as an instance. He obtained, a hybrid from Nicotiana *rustica* and *paniculata*. Nicotiana *rustica* was the female plant, *paniculata* the male. The hybrid, like all the others which he brought up, had imperfect stamens, and kept the medium between the two species. He afterwards impregnated this hybrid with Nicotiana *paniculata*, and got plants, which much more resembled the last. This he continued through several generations, till in this way, by due perseverance, he actually changed the Nicotiana *rustica* into the Nicotiana *paniculata*. By these and other experiments, often repeated, and made in various ways and upon other plants, it is quite obvious, that there is no preformation in plants.

According to the theory of Epigenesis then, the fluids of the male and female are mixed, and an offspring is obtained from these two, which in form and properties resembles both father and mother.

It were to be wished that all theories could be proved in as convincing a manner, as generation can be demonstrated by the number of discoveries on this head, made in the animal and vegetable kingdom.

§ 302.

But there have been philosophers, both in former and modern times, who in plants have altogether denied the existence of sexes. Smellie seems to favour this opinion, as he repeated an experiment of Spallanzani's, with a female plant of hemp, which he kept remote from all male plants, and notwithstanding obtained, though in a small quantity, perfect seeds, and hence he deduces his argument. But such experiments are too difficult to be free from error, and who can positively assert, that he has not, even with the greatest attention, been deceived? Spallanzani placed his female plant in a room, to which no insects could get, and, for the greater security, likewise covered it. But could he, before the first flower appeared, distinctly enough distinguish the female plant of the hemp? And could not a very small, minute insect escape his eyes, and effect a fecundation? Besides, how often do we find on hermaphrodite plants a single stamen, which perhaps was here the case? The few seeds which he got, prove, that a few single parts were necessarily fecundated. But even supposing that in hemp, the female plant produces ripe seeds without fecundation, can we apply any conclusion however just from this single plant, to every other vegetable. We have in the animal kingdom an instance in the Aphis, an insect which, without the aid of a male, propagates itself till autumn. But who would, from this isolated observation, founded as it is in truth, attempt to deny in all animals the existence of a difference of sex? Since Gleditsch first, in a botanic garden, impregnated the Chamaerops *humilis*, which is a female plant, with pollen of the male plant, which Koelruter sent to him from Karlsruhe, and obtained ripe seeds and young plants, which before never had been possible, thousands of similar experiments have been made, which put it beyond doubt that two sexes exist in plants. Every person may, indeed, easily convince himself of the fact, by repeating such experiments on the species of melon and gourd, and everywhere in the vegetable kingdom, he will find two distinct sexes.

§ 303.

The seed, (§ 295), already exists in the germen during the time of blooming, before fecundation takes place, and contains a very clear liquor, called by Malpighi the Chorion. With this, most likely, the fecundating particle of the male semen is mixed, and thus produces the embryo of the future plant. Koelreuter, however, thinks that the moisture of the stigma, which he, according to his favourite idea of an oily, impregnating fluid in vegetables, supposes likewise to be oily, is mixed with the fluid of the male, and that these two combined, are conveyed into the seed. However, be this as it will, a great alteration is observed to take place in the seed sooner or later after fecundation, according to the variety of plants. For in the neighbourhood of the navel a small vesicle appears, filled with some liquid. The vesicle is called the *sacculus colliquamenti*, and the liquor in it, the *amnios*. This vesicle grows larger, absorbs the chorion, which at last entirely disappears, so that the cuticle finally becomes the *membrana interna* of the seed, (§ 116). The *amnios* grows hard, and forms the cotyledons, (§ 116). As soon as the vesicle shews itself, the embryo of the future plant likewise appears gradually, which consists in the corcle, *(l. c.)* It is formed gradually, and becomes visible in the sunflower, (Helianthus *annuus)*, three days after impregnation; in the cucumber, (Cucumis *sativus)*, a week after; and in meadow saffron, (Colchicum *autumnale)* some months after. It is flaky in the beginning, but in time becomes, like the vesicle which contains it, larger and firmer. The vesicle does not in all seeds increase in the same form, in some it grows larger in its whole circumference, in others it grows longer towards one extremity, which runs straight out to the opposite wall, and the sides are extended.

Thus the seed comes to maturity, and when perfectly ripe, separates in different ways from its mother plant, and begins a new life itself, passing through all the scenes again, just now explained. This is the common way in which plants are propagated. But we have plants, which do it in another way besides evolving their seeds. At the stem, or near the angles of the leaves, by nature or even through accident the spiral vessels of plants form sometimes knots, which become buds, and separating spontaneously from the plant itself, send out roots and leaves, thus forming an entirely new plant of the same species. Such plants are called viviparous plants, (*vegetabilia vivipara).* Several species of garlic, *(Allium);* the Lilium *bulbiferum ;* Poa *bulbosa* and other plants, do this spontaneously. The garden tulip, (Tulipa *gesneriana),* exhibits this curious phenomenon by means of a simple manoeuvre of art, if the flower is cut off, before impregnation has taken place, and the stem with the leaves be allowed to remain, provided it be in a shaded spot. Several succulent plants, for instance, Eucomis *punctata,* do it when treated in the above manner. Gardeners increase plants by layers, suckers, grafts and inoculation, in a similar manner.

The bud of a tree or shrub, when grafted into another stock, will there be unfolded, and must indeed be regarded as a different plant altogether. It is not changed in its nature, but grows as if placed in the earth ; the stem only serves to convey the imbibed sap to it, which it must itself digest according to its nature.

Agricola and Barnes, it appears, were more successful in these operations, for they placed buds directly in earth, and produced perfect plants.

§ 304.

It is remarkable in this kind of artificial increase, that where branches or buds are in any way formed into new plants, by layers, grafts, or inoculation, the plant from which they were taken, does not propagate as species, but only as *variety*. If we take the part of an individual, and convert it into a particular plant, in this way all the varieties may be multiplied. The seed therefore propagates only the species which may grow from it under many different appearances as varieties, but in the branch as in the bud the germ is already formed, and it is totally impossible that the shoot issuing from them can alter in the least. Thus is the apple of Borstdorf propagated by grafts; inoculation will always remain the same, but from the seed will be obtained many varieties entirely different.

§ 305.

The stem of ligneous plants, (§ 264), annually adds a new ring of vessels. The first circles begin to become ligneous on their sides. The wood has, in general, when young, a yellowish white colour, which, according to the species of the plants, assumes a darker hue every year. The quick circulation of the sap takes place only in the young vascular circles; in the older ones the sap is carried along much slower, and they have their irritability greatly diminished. The life of every shrub or tree consists only in the young rings of these vessels, which is called inner bark, (§ 280), and the plant must die when this is wounded. Thus, if a ligneous plant has performed its offices for a number of years, then the innermost ring begins to be obstructed, and to become more and more dense; this occasions that those lying next them no longer obtain their moisture from them. They therefore begin to move their sap slower, and the youngest vascular circle becomes gradually thinner and thinner. At last the sap stops likewise in the following ligneous ring; the young vascular circle cannot form itself completely; few buds are now unfolded; the small number of leaves cannot prepare sufficient sap for the whole, and the common certain lot of organized bodies, death sets the final insurmountable bound to vegetation.

§ 306.

In herbaceous plants all the vessels of the stem become dry and hard in one year, and as they can no longer convey the sap, consequently the stem decays at the end of the year. Their root forms, as the stem of ligneous plants does, annually a new vascular circle, and it dies in the same manner, when all those circles have become too ligneous. But such herbs, the roots of which are annually renewed, are of constant duration. The old root dies, its fibres being entirely ligneous, but a new one appears, and is to be considered as a young plant.

§ 307.

Herbs, whether they live one year only, as the annual plants, or two years, as biennial plants, become so exhausted by the formation of the flower and fruit, that the irritability of their vessels becomes much impaired; they therefore become quite ligneous, and the root and stem must decay after their fruits are ripened. They may, however, be preserved for several years, if their flowers, when in the bud, be taken off. The same happens when their flowers are filled, in which case fecundation does not take place and, consequently, no fruit is formed. These vessels retain that irritability which is necessary for their duration, and which would have been lost by the wasting of their strength, and their fibres become ligneous more slowly.

§ 308.

Natural death, is not the same in all vegetables. As in all organized bodies it ensues in three ways. First, by the induration of the fibre, as in trees, shrubs and under shrubs. Secondly, by the powers being exhausted, (§ 307), as in annual and biennial plants. Lastly, by dissolution, as in soft Fungi and the species of Boletus. These plants imbibe a great quantity of moisture, which increases with their age. In them no part becomes ligneous, but they die in too softened a state, and putrify from a superfluity of moisture.

§ 309.

The duration of life differs greatly in different plants. Some species of Boletus require only a few hours for their evolution, and as soon again decay. Several fungi live only a few days, others weeks and months. Annual plants live three, four, or at the utmost eight months. Biennial plants continue sixteen, eighteen, and even twenty four months. Many herbaceous plants grow a few years, but several a long series of years. There are some shrubs and trees which can live eight, ten, a hundred, even a thousand years. With us the oak and lime-tree attain to the greatest age. The former may live six or eight centuries and above, and stems, almost as old, have been seen of the latter. But the trees, which in our globe arrive at the greatest age, are beyond doubt the Adansonia *digitata*, (§ 267); the Pinus *Cedrus,* and the different species of palm. The Adansonia probably lives longest of all, as its age is computed to be one, if not many, thousand years.

VI. DISEASES OF PLANTS.

§ 310.

Plants are, like all other organized bodies, subject to a great many diseases. The most common causes are, improper soils, preternatural habitations, late frosts at night time, long continued rain, great drought, violent storms, parasitic plants, insects and wounds of various kinds.

Disease we call in plants that preternatural state by which their functions, or at least some of them, suffer, and the purpose for which they are destined prevented.

§ 311.

The diseases of plants are of different kinds; they attack either the whole plant, and are then called general diseases; or they only affect single parts, when they get the name of local diseases. We style those diseases Sporadic, which out of a great number of the same species of plants, only attack one or two, as consumption. Epidemic, on the contrary, when they attack a great number of plants, such as gangrene, necrosis, rubigo, and others.

§ 312.

The diseases of plants are either such as attack them externally, and are occasioned by various causes, or they proceed from internal sources. The former are, upon the whole, much more easily healed than the latter. The diseases, which proceed from internal causes, originate in the increased or diminished irritability of the fibre, and this may be also produced by a variety of causes.

The cure of plants is very simple: either the injured part is cut off, or the soil, the situation, and the degree of temperature, altered. To these expedients only, the healing of all plants is restricted. In vegetables, as well as in animals, diseases occur which are incurable, as consumption, canker when it is concealed, mutilation, deformity, &c. Most of them, however, may be remedied.

§ 313.

Vulnus, or a wound, is the separation of the solid parts by external violence. It may be occasioned purposely by cutting off branches, or accidental rubbing off; by friction of cattle; or by friction against another object, when the wind agitates the stem; by the bite of animals; by the falling off of the parasitic plants; or even by very large hailstones. In all these cases, it is necessary to prevent the access of air to it, by some good firm cement, or grafting wax. But if the wound has remained long uncovered, and exposed both to wind and rain, and is of a great size, then the affected part must be cut off down to the sound wood, to prevent greater mischief, and the whole afterwards be covered with wax.

The means of preventing wounds are obvious.—Branches must be cut off cautiously; the access of cattle must be obstructed; trees brought up, so as not to be fastened to stakes; or, if it cannot be avoided, to place three or four posts or stakes round each, and tie them up very gently. In violent storms, it is indeed better to let them loose, and leave them to themselves. Parasitic plants must be eradicated. Against the bite of smaller animals, and hail, precautions cannot always be taken.

§ 314.

Fractura. Fracture is the separation of the stem and branches into many pieces. This may arise from the violence of the wind, from too great an abundance of fruit, much snow, or even from lightening. It is remarkable, that lightening runs along every species of trees, almost always in a different manner. The birch (Betula *alba*,) is, in this respect, different from all other trees, that the lightening never runs along its stem, but only at the top beats off the boughs almost in a circular direction.

A fracture, if not complicated, and on branches or young stems only, may be healed without difficulty. But when accompanied with contusion, or happening in trunks of old or gummy trees, no way of recovery is known.

In young trees and branches, even sometimes in old ones, when instantly discovered, fractures heal easily, especially in spring till the end of June, provided every part be brought into its natural position, firmly tied up, and properly supported. But if there is contusion, or if a thick stem or bough is affected, the bough must be cut off, or the stem cut down, to get new shoots from the stock or from the root.

To prevent such an accident, trees with fragile boughs must be, as much as possible, sheltered from the wind. Fruit-trees should not, when pruned, have all their gems left; and care should be taken in gardens, that the snow do not overload the boughs. Against the flash of lightening, no means are of any service, except bringing conductors—a plan which would be too expensive, and even impracticable.

§ 315.

Fissura. Fissure is the separation of the solid parts into an oblong cleft, which ensues spontaneously. It proeeeds from two causes; fulness of juice, *(polysarca,)* or from frost.

To heal a split, nothing else is required than to put good grafting wax on the wound, that the rain or other contents of the atmosphere may not destroy the stem.

To prevent clefts, the bleeding or scarifying, as it is called, of such trees, the bark of which is very hard, may be of service. A moderate incision is made through the bark longitudinally; and a plant that has too rich a soil, by which it becomes too succulent, should be transplanted into a poorer soil. To defend them against frost, plants should be covered with straw.

A cleft occasioned by frost, sometimes degenerates into a chilblain, *(pernio,)* from which afterwards, especially in oaks, a blackish sharp liquor exudes, which at last produces exulceration, (§ 327.)

§ 316.

Defoliatio notha is when the leaves fall not at the proper period, but much earlier. It is occasioned by men, insects, acrid fumes, dust, and constant dry weather.

In whatever way it may happen, all depends on the nature of the plant affected with it, and on the season of the year in which it happens. If it be a fast growing tree, and the injury happens before August, the tree may, if taken good care of, easily get leaves again, only it will have smaller foliage for the present season. But if the leaves fall after that period, and cool weather comes on earlier than usual, or if it happens at a much later season, the plant may be unwell for several years before a complete recovery takes place. If, on the contrary, it happens late in autumn, just before the natural fall of the leaves, then it has no bad consequences; except the plants be natives of a warmer climate, and the branches, which have appeared already, be not yet hard enough, in which case they will lose those branches, and perhaps some of the older ones, by the invasion of cold. The defoliation by men, which is performed sometimes in spring, particularly with the mulberry-tree for bringing up the silk-worm, should be avoided, or at least done with moderation.

Insects which are noxious to plants, should be accurately known, and their way of propagation understood, in order to obviate the bad effects which they produce, and to check their too great increase.

Change of place is the only means of preventing the noxious influence of acrid fumes, of great manufactures and iron-works and the like, as well as of dust.

In long continued drought, careful watering is adviseable.

The falling off of the leaves in autumn is quite consistent with nature, and of no bad consequence whatever; except, perhaps, when the leaves are dropping off too soon, on account of early night frosts, and these can affect only delicate foreign plants, of which care should be taken.

§ 317.

Haemorrhagia is of two kinds, spontaneous or occasioned by wounds.

The birch and mapple, when wounded, emit a great quantity of juice, which, when allowed to flow too copiously, may end in the death of the plant.

Spontaneous haemorrhagy arises from the great irritability of the plant, and the soil is generally the accidental cause. The soil is either what, in common language, is called too rough; that is, it promotes too rapid a separation of the juices, which, on account of their large quantity, cannot be received into the vessels, and therefore must be discharged, and then they acquire in the air a corrosive property, by which the parts are destroyed; or the soil is too rich in general, rendering the plant full of juices, but unable to retain the moisture, which, therefore, without corroding the posterior parts, they discharge, or deposit only externally their gummy constituents. In most cases, spontaneous haemorrhagy is incurable.

Spontaneous haemorrhagy, from superabundance of sap, is either gummous, as in fruit-trees, or of a watery nature, as in the vine. This last species has been styled *lacrymatio*. The gummous haemorrhagy proves rarely fatal, but should not be allowed to make too much progress, and the wound should be healed up by wax. The watery haemorrhagy in the vine, has no bad consequences whatever; for this plant is the same in winter as all ligneous plants, (§ 281). The radicles of it, which have been formed during the cold season, imbibe a great deal of moisture from the ground, which they convey to the stem. But as the weather is not soon enough favourable for the shooting of it, and as the radicles imbibe more sap than the tender stalks can contain, the superfluous sap exudes from the gems or buds. In warm climates, the vine does not lacrymate; for there the leaves can unfold themselves instantly, and the sap of course is properly digested. This watery discharge of the vine is not, therefore, to be considered as a natural secretion, peculiar to the plant, but as the effect of cold climates. It, however, does not hurt the plant.

§ 318.

Albigo, or mildew, is a whitish mucilaginous coating of the leaves of plants, which often causes their decay. It is produced by small plants, or by insects. The first kind appears on the leaves of Tussilago *Farfara*, Humulus *Lupulus*, Corylus *Avellana*, Lamium *album*, *purpureum*, and others. It is a small species of fungus, of great minuteness, which covers the leaves: Linné calls it Mucor *Erysiphe.*

The second kind is a whitish slime, which some species of Aphis deposit on the leaves.

As soon as there is the least appearance of mildew, all the leaves stained with it should be plucked off and burned. In scarce and delicate plants, the leaves ought to be washed. But where it is produced by aphides, a weak decoction of the dry leaves of tobacco will be found most serviceable.

But if all parts of a plant are attacked, and the plant is hard and of long duration, then the parts must, according to the nature of the plant, be taken off. If it is an annual plant, and of great delicacy, it will be best to wash it, with a brush dipped in the decoction of tobacco, and afterwards to expose it to the open air.

§ 319.

Melligo, or honey-dew, is a sweet and clear juice which, during hot weather, is frequently found upon the leaves, rendering them sticky, and, especially when there is a want of rain, causing them to fall off. This sweet matter is likewise secreted by aphides, from peculiar glands at the anus.

In tender plants, washing with water, or with the above decoction, is of great benefit; the fumes of tobacco, likewise, kill the insects.

§ 320.

Rubigo, or rust, appears on the leaves and stems of many plants. It consists of yellow or brown stains, which, when touched, give out a powder of the same colour which soils. Microscopical examination has shewn, that the rust-like matter is a small fungus, which is called Aecidium, and the seed of which form this brownish soiling powder. We find them frequently in the leaves and stems of Euphorbia *Cyparissias*, Berberis *vulgaris*, Rhamnus *catharticus*, of some gramina, of wheat, oats, &c. If they are very numerous, especially in the different species of gramina and corn, consumption of the whole plant is the consequence.

Little can be done against this affection. In grain, some have recommended to moisten the seed, before sown, in salt or lime water, or to sow grain from countries where this disease does not prevail. Precautions are of no use.

§ 321.

Lepra is frequently met with on the trunks, especially of young trees. If trunks are so entirely covered with algae, that the pores of the cutis are obstructed, we call the distemper *lepra*. Old trees have their trunks full of algae, without suffering any injury, provided the smaller branches be free of them. But if young trees or shrubs grow in too sterile a soil, in too thin a stratum of fertile soil, in gravely soil, in improper situations, too moist or too dry, if they are, against their nature, too much exposed to wind, then they sicken, their bark cannot perform, with proper vigour, the functions peculiar to it as the skin of the tree, and they grow at last, even at their young boughs, all over with fungi of all kinds. Vigorous adjacent plants, which are perfectly sound, will have few or no fungi on their stems.

The lepra increases sickness in plants, and they die at last of a consumption, if not cleared of the fungi, if their cutis is not washed, and they are not transplanted to better situations and more proper soils.

§ 322.

Gallae, or galls, are produced by small flying insects, the Cynips of Linné. Galls are round, fleshy, variously shaped bodies, which appear on the stem, petioles, peduncles, and the leaves. They are formed in the following manner: The little insect pierces with its sting the substance of the plant, and deposits its eggs in this small aperture. The few air vessels thus injured get a different direction, and twist round the egg. The irritation which the sting produces, occasions, as always in organized bodies, a greater flow of the sap, towards the wounded place; the sap is deposited in greater quantity than it ought to be, and a fleshy excrescence arises. The little larva which leaves the egg is nourished by the sap, grows up, changes into a pupa, and escapes at last as a perfect insect, which propagates itself again in the same way.

It is singular, that each particular fly produces a gall of a peculiar form. This, perhaps, may depend on the peculiar structure of the eggs of each species; for we find, that the eggs of different insects, when viewed with the microscope, assume peculiar shapes. On the oak-tree, we find a variety of galls, likewise on the Salix, Cistus, Glechoma, Veronica, Hieracium, Salvia, and other plants.

The galls of Salvia *pomifera*, which got its name from that circumstance, are said to be of a pleasant taste, and are considered as an excellent dish in the oriental countries.

To remedy this affection, we can do nothing, but cut off the galls as soon as they appear; yet this can be done only in very delicate plants, which we wish to preserve. The disease, however, rarely proceeds such a length as to hurt the plant materially.

§ 323.

The *Folliculus carnosus foliorum*, is a gall of a particular kind, which is subulate and acute. It is found in Populus *nigra* and Tilia *europaea*, and covers the whole surface of the leaf. It arises in the same way as the former, and by its great number, sometimes sickens the plant.

Contorsions, *(contorsiones)* owe their origin likewise to insects, which produce a swelling and contortion of the leaves; hence they become contorted, which is the characteristic feature of the disease. It occurs in Cerastium, Veronica, Lotus, Vaccinium.

§ 329.

Verruca, or wart, is a small protuberance, which occurs chiefly in fruits, for instance in apples. Here insects are not the cause, but accidental occurrences. Of the same kind are the *(naevi* s. *maculae)*, moles. They arise from wounds of the cutis. Both diseases are not hurtful, and, as yet, we know no means to prevent them.

Tuber lignosum is met with on trunks of trees. It seems to be produced partly by insects, partly by changes of weather. It arises from a disturbance in the active vessels of the inner bark, which by the application of stimuli, several times convolve, without forming buds or boughs. They form instead of this, great knobs, which often, in a bad situation, especially through moisture, exulcerate. It not unfrequently grows very large, without the least injury to the tree.

§ 325.

Squamationes, or spongy swellings, are produced like galls (§ 322). A small insect lays its eggs in the apex of a bud. Thus injured, the branch, which was to be formed from the bud, cannot be properly unfolded, it remains quite short; all its leaves, therefore, expand themselves from one point, but they are of small size. The whole has somewhat the appearance of a rose. This may be often seen in willows.

Such spongy swellings are of bad consequence when in great numbers. The only way to extirpate them, is, to cut them off, before they are properly formed.

§ 326.

The *Bedeguar* occurs in roses only, and has the same origin as the former, with this difference, that the insect which gives rise to the Bedeguar, deposits a number of eggs in one heap, in the middle of the bud. From this a fleshy mass of the size of a fist arises, which is covered all over with hair-like coloured elongations, but never has leaves.

§ 327.

Chlorosis, is that affection of plants, when their green colour entirely disappears, and all their parts grow whitish. It arises from diminished stimulus, the plants cannot excrete their oxygen, which therefore is accumulated. There are three causes of the disease, want of light; insects; and bad soil. From what has been said before, (§ 285), we know that a healthy plant emits oxygen gas in sun light, and that the accumulation of this gas, when not emitted, makes the green colour disappear, (§ 279).

As soon as a plant is deprived of light, it cannot disengage the oxygen, hence it assumes a white colour, which however instantly goes off, when the rays of the sun are again admitted. This is the reason why plants, in dark rooms, between great masses of stone, in deep clefts of rocks, beneath the dark shade of shrubs and trees, &c. grow pale, and of a whitish colour.

Insects which bite off the radicles of plants, or even nestle in them, and consume their food, debilitate their vessels, render them insensible of the stimulus of light, and at last chlorotic. This occurs very frequently in Secale *cereale*. Here no remedies are of any use.

Improper soil, from which plants do not get a sufficient quantity of proper food, sometimes renders them chlorotic. In such cases plants may recover by change of soil.

§ 328.

Icterus differs from chlorosis, only in its colour, and by its cause, which is cold coming on early in autumn. It is indeed the natural death of the leaves, and can only hurt the plant itself, when the cold begins in autumn before the due time.

§ 329.

Anasarca, or dropsy, arises in plants from long continued rain, or too profuse watering. Single parts in this case, are preternaturally swelled, and commonly putrify. Some of the bulbous and tuberous roots, for instance, are often greatly swelled after rain. Fruit becomes watery, and tasteless. Seeds do not get ripe, or the plant pushes out young shoots unseasonably from the stem. Most of the succulent plants suffer from too copious a supply of water.

Anasarca in plants is generally incurable.

§ 330.

Phthiriasis is that disease of plants, where the whole of it is covered with small insects, which suck out all its sap, suppress the function of transpiration, and of course hinder the farther evolution of its parts. This disease is produced by three different species of insects. By the Aphis, of which each plant has almost a peculiar species. By the Coccus, of which there are various species. That which in our hot-houses is mostly met with, the Coccus *Hesperidum*, is the most dangerous; those which are commonly found on the roots of Sceleranthus, Polygonum and others, are less noxious. The disease is lastly produced by the Acarus *tellarius*, a small mite, which in hot-houses likewise spins a very delicate web over the leaves of the plants, and thus destroys them. Against the Aphis, careful cleaning, or even brushing with suds, or a decoction of tobacco; or strong fumigation with tobacco; or sulphur in close rooms, may be of service. The same means may also be employed against the second species, where it may be likewise very beneficial to place the plant as soon as the temperature is mild in the open air, in a shady but airy place. This last destroys the canker, which in hot-houses chiefly attacks the genera Sida, Hibiscus, Dolichos and Phaseolus.

§ 331.

Verminatio, or worms, is not as in the animal kingdom, produced by worms, but by the larva of insects. The stem, leaves and fruits are attacked by it. The stem of some trees is very often eaten through, and must sometimes entirely decay on this account. The willow, (Salix *alba)* ; horse chesnut, (Aesculus *Hippocastanum)* ; the Typha *latifolia*, may in regard to the stem, serve as very common instances.

The leaves are often inhabited by the well known mining-worm, especially the leaves of cherry-trees.

Fruits, as plumbs, apples, pears, hazel-nuts, and the grain of corn, and the like, are inhabited by the larvae of insects, which sometimes destroy them.

Except the destruction of the larva, no remedies will resist these ravaging enemies.

§ 332.

Tabes, or the consumption of a plant, is frequently a consequence of the already mentioned diseases, or those which we have still to explain. It may however also originate from sterile, or improper soil, unfavourable climate, aukward transplanting, exhaustion of strength from too frequent flowering, insects, ulceration, &c. The whole plant gradually begins to decline, and dries up. As soon as this disease really appears, help is rarely possible.

Teredo *pinorum*, is a kind of tabes, which attacks principally the alburnum and inner bark of pines. The disease arises from long continued dry weather, or violent frost of long duration, especially after preceding mild or warm weather, and violent gales of wind. Its signs are, an unusual discolouring of the acerous leaves, which are more or less of a reddish yellow hue. A great number of small drops of resin appear on the boughs, and, lastly, a putrid turpentine-like odour spreads in their neighbourhood; the bark comes off, and the alburnum presents a blackish blue appearance. At the same time the well known beetle appears, with several similar species of insects. The Teredo is an incurable disease, and in large forests nothing more can be done than not to permit the removal of the pointed leaves or the moss round the roots of the pine trees, as the trees are thereby weakened, and so much sooner exposed to this misfortune.

§ 333.

Debilitas, s. *deliquium*. Plants which suffer from debility have all their parts, stem, leaves, flowers, &c. hanging down quite relaxed. Debility owes its origin to foul air, want of light, of leaves, or of moisture, too strong light and other causes, which we must endeavour to remove, in order to remedy this evil.

§ 334.

Suffocatio incrementi, is a sterile or weak growth, the leaves become pale, and smaller, and at last the whole plant decays. It is different from consumption in this, that the causes of it are only accidental and may be removed, so that the plants may still recover. Bad growth is occasioned by parasitic plants, twining plants, and too glutinous a soil. When those impediments to growth are removed the plants will soon recover.

§ 335.

Exulceratio is a corroded part of a plant, from which proceeds an ichorous filthy water. It takes place after wounds, which are not properly taken care of, or which have such an unfavourable situation, that rain or snow may stagnate in them. Farther, it is produced by insects, or spontaneously by unknown causes. No ulcer heals of itself in plants, it is more or less destructive, the slower we are in bringing assistance. All ulcerated parts ought to be taken off, and the sound parts covered with a coating of grafting wax, or of Forsyth's cement. An ulcer often corrodes wood, pith, or other parts of trees, from neglect of the gardener; in this case, all that is affected, must, without loss of time, be cut away, and as just now mentioned, the access of moisture must be prevented by the application of some grafting wax or cement.

From unknown causes, the bulbs of hyacinths and other fleshy roots exulcerate. We must endeavour to effectuate their cure by putting them in a dry place, taking off the diseased part, and covering it with cement. However, we rarely succeed, as the bulbs are mostly destroyed to the very centre *.

* The best remedy for plants is the grafting wax, if well prepared, but in many cases, especially for large wounds, Forsyth's cement, for the receipt of which the king of England payed 15000 dollars, is by far preferable to the former. It consists of sixteen parts of cow dung, eight parts of dry lime taken from an old building, as much charcoal, and one part of sand out of a river, which are to be mixed together

§ 336.

Carcinoma arborum, or a cancerous affection, occurs principally in fruit-trees, when they lose too much gum, and this undergoes an acid fermentation. This disease appears frequently in low lying gardens after deluges. A great spongy excrescence rises, which even in the driest weather discharges an acrid ichor, which corrodes every thing. We distinguish two species, the open and the latent cancer. The first species is easily seen, and cured by simply extirpating the affected part. But the second species may have spread far in length and under the cortex, before it is discovered. We must then hasten to save the tree, and after removing the wounded part apply Forsyth's cement to it.

into a thick salve. In place of the cow-dung, ox's blood, and instead of the lime, dry chalk may be employed. This cement is to be spread thinly on the affected part, and to be rubbed with a powder, consisting of six parts of charcoal, and one part of the ashes of burnt bones or carbonate of lime, till the surface of the cement is as smooth as if polished. Forsyth did wonders with this preparation, and cured with it all wounds of plants without any further trouble. It does not keep well, and therefore only as much of it must be prepared, as is wanted for the time, or, if it is to be preserved, it must be sprinkled with urine. It should further only be applied during dry weather, by which means it covers the wound with a cortex. Rafn asserts, he had experienced the same good effects from a mixture of pounded coal and potatoes, or some other soft substance, and even prefers this to Forsyth's mixture.

To obviate this disease, we must improve the station of the plant, and endeavour to prevent too much formation of gum in fruit trees.

§ 337.

Necrosis, or dry gangrene, is that disease which causes the leaves or other parts to grow black and dry. It arises from late night frosts, severe cold in winter, burning heat, suppuration of the sap in single branches, and by smaller plants.

Late night frosts, very frequently kill young shoots of plants, which therefore grow black, and shrink. No other preservative can be used against this than covering young plants as soon as cold nights may be dreaded. Some assert, that they have derived great advantage from conductors of frost, which consist of a compactly twisted cord of straw, directed into a vessel with water. From severe winter cold, foreign trees suffer chiefly, and such of our native plants as are very delicate. Their inner bark freezes, becomes black, and it is impossible to save them. All the wounded part must be clipped, and the main trunk with the roots only be allowed to remain, to produce new shoots. Intense heat will produce the same bad effects in gardens, or even in forests, where foresters are permitted to remove the mosses and dry leaves from the roots. Single branches sometimes, by the too rapid growth of others, are deprived of their necessary food, and wither away. This may happen without any injury to the plant. Small fungi occasion this disease, in the bulbs of the saffron, it is a nuredo which destroys them. On the gold coast of Africa, a wind blows called Harmattan, which kills the plants, making their leaves dry and black.

§ 338.

Gangraena. Plants affected with gangrene become soft and moist in some single parts, which at last dissolve in a foul ichor. It chiefly attacks fruits, flowers, leaves and roots, rarely the stem. Gangrene arises either from too moist or too fat and luxurious ground, from infection and contusion. It scarcely admits of a cure, as it infests only single parts, but if the causes which give rise to it are removed it may be prevented.

§ 339.

Ustilago, appears especially in the species of gramina and grain; rarely in other plants; sometimes in Scorzonera, Tragopogon, &c. It arises from a small fungus, which occupies the whole ear, which therefore cannot evolve. Every part of it, on the contrary, becomes a black, soiling mass. Moist seasons are most favourable for its evolution, and its formation is, under such circumstances, very rapid.

That corn may not be affected with it, such grain only should be sown, which has not been kept in damp places, nor has been got from where the disease prevailed. It is natural to suppose that the infection would by such means be propagated. Neither should the grain be placed too deep in the ground, especially where the soil is very fat or moist. When, however, it is once begun, the plants diseased cannot be cured. In tender and scarce garden plants, something may be done by amputating the diseased part before its perfect formation. But, in general, this expedient is not adviseable.

§ 340.

Mutilation happens especially in flowers, and the name *flos mutilatus* is used, when single parts of a flower, particularly the corol, are not come to perfection. The causes of this mutilation are unfavourable climate, and improper soil. Flowers, notwithstanding this mutilation, often bear perfect seeds.

The species of violet, Viola *odorata* and *canina*, often produce in our climate, if the weather is not warm enough, flowers wanting the corols. Campanula *hybrida* has here no corols, but is said to have them in France and Italy. In several of the campanulate flowers we see frequently the corol wanting; for instance, in Campanula *pentagona*, *perfoliata*, *media*. Some other plants, as Ipomoea, Tussilago, Lychnis, are liable to the same accident. Ruellia *clandestina* is thus called, because it has sometimes flowers without the corols, sometimes with them. The same is said to be the case in its native country, Barbadoes.

Hesperis *matronalis*, during long-continued moist weather, from superabundance of food, frequently bears blossoms, where the corol becomes a second calyx.

The Dianthus *caryophyllus* augments the scales of its calyx so much, that the flower becomes somewhat like the ear of wheat, and the corol never appears. Less conspicuous is this disease, when a few stamens only are not so properly formed as the rule requires.

§ 341.

Monstrositas is the preternatural form of single parts or a whole plant. In the flower and fruit the monstrosity is often such as to prevent their use entirely.

The stem is sometimes writhed, bent, knotty, too much depressed, and in a lying posture. Cold climates in general make plants rough, small, and crippled. On high mountains the tallest trees are at last reduced to a small size.

A monstrosity is sometimes observed in leaves by their becoming deformed, either larger or more numerous, thicker, or frizzled. Every person has seen trefoil with four leaves, or the preternaturally red coloured leaves of the beech tree, and other varieties belonging to this class.

Fruits likewise are variously deformed, they are either very large or very small, grown together, distorted, crooked, and the like. These may, however, produce good seeds. But fruits which are doubled, where, when one is cut, a second one appears in its interior, as sometimes happens in citron, and fruits which have no seeds; as for instance, the Bromelia *Ananas;* Musa *paradisiaca;* Artocarpus *incisa;* Berberis *vulgaris;* intirely fail us in the end for which they were intended by nature.

Monstrous flowers are of no value for the botanist, as their sexual organs are wanting, and he is unable without these to ascertain the genus. They are only of some importance to him, if they elucidate any points in Physiology. They are particularly agreeable to garden amateurs, who have so vitiated a taste, as to despise simple nature in all its beauty, and with care often transplant these deformities into their gardens.

The deformities in flowers are the following:—Flos *multiplicatus*, a double flower; Flos *plenus*, a full flower; Flos *difformis*, a deformed flower; and lastly, Flos *prolifer*, a proliferous flower.

§ 342.

Flos *multiplicatus*, a double flower, is the beginning of a full flower. Flowers are styled double, when their petals exceed the usual number, but stamens and pistil still remain to accomplish impregnation, and to produce ripe seeds. The first beginning of a double flower is the corolla *duplex*, or *triplex*, when the corol becomes double or treble. Monopetalous corols are often double; for instance, Datura; Campanula; but polypetalous corols still more frequently. As long as the pistil remains perfect in a flower, and it can bear seeds, so long the flower is called double. The cause of this deformity is the same as in the following. Very little care is taken to remedy this evil, as gardeners, even like to see full and double flowers. But if botanists wish to see double flowers of herbaceous plants in their natural state, they ought by all means to give them by degrees worse and worse soil.

§ 343.

Flos *plenus*. A full flower is that where the petals have become so numerous as to exclude both stamens and style altogether. As such flowers want the necessary organs for impregnation, they will never be able to produce seeds. The full and double flower both originate from too great richness of soil. A number of vessels become stuffed with nourishing sap, in such a manner, that the petals and stamens split and are changed into more petals. Some flowers are so full that the calyx bursts.

Monopetalous flowers are rarely full; such as, Primula; Hyacinthus; Datura; Polyanthes.

Polypetalous plants are oftener full; as, Pyrus; Prunus; Rosa; Fragaria; Ranunculus; Caltha; Anemone; Aquilegia; Papaver or Paeonia, and many others *.

§ 344.

Flowers which have nectaries in form of a spur or acup, usually increase the spur or cup, and lose the petals altogether, or they retain the last in their natural situation. Or they lose sometimes the spur or cup, and enlarge only the petals.

Of the first kind Aquilegia *vulgaris*, Narcissus *Pseudo-narcissus*, may serve as instances. In the

* Dianthus *Caryophyllus* and Papaver *somniferum* have been brought forward as fair instances to prove, that full flowers may produce seeds. But this proceeds from confounding a full flower with a double one. The last may bear seeds, but a full flower never.

Aquilegia the petals are dislodged, and the spur only increased in number. In this case, then, many spurs are enclosed in one another like so many cornets. In Narcissus the petals remain natural, but the nectarium is multiplied.

The same plants likewise present instances of the second kind; in Aquilegia, the spurs are in this case entirely wanting, and the petals increase in number; in the same way Narcissus may sometimes want the nectarium, and the petals become full. The violet and the larkspur become full in the same manner.

§ 345.

Flowers which have one or a few stamens only, are seldom full. When they are full, and this is exceedingly rare, it is only in such plants as have a monopetalous corol. As an instance of this kind, I shall mention Jasminum *Sambac*. Some of the natural families never yet produced any double or full flowers. Such are,

Palmae, (§ 146, 1).
Calmariae, (ib. 3).
Gramina, (ib. 4).
Apetalae, flowers without petals.
Amentaceae, (ib. 50).
Coniferae, (ib. 51).
Tripetaloidae, (ib. 5).
Orchideae, (ib. 7).
Scitamineae, (ib. 8).
Oleraceae, (ib. 12).
Inundatae, (ib. 15).
Bicornes, (ib. 18).
Tricoccae, (ib. 38).

Stellatae, (ib. 47).
Umbellatae, (ib. 45).
Asperifoliae, (ib. 41).
Verticillatae, (ib. 42).

Some of the last, however, afford an exception. In those flowers which are styled Personatae, it has been only observed in the species Antirrhinum. The papilionaceae, have been found full in a few instances only; as in Coronilla, Anthyllis, Clitoria, Spartium.

§ 346.

Full flowers, as we have just now mentioned, occur most frequently in polypetalous corols, but the monopetalous are sometimes seen full, though this was formerly denied; as instances are, Colchicum; Crocus; Hyacinthus; Polyanthes; Convallaria; Polygonatum. The polypetalous corol becomes full by its petals, the monopetalous by its laciniae.

Full flowers are somewhat of the appearance of compound flowers, and consequently may be mistaken by the student for such; but they are easily distinguished by the following marks:—1. In the centre of a full flower remnants of the style are still to be seen. 2. Each petal is not furnished with stamens or a style. 3. After they have blossomed, nothing remains, and no fruit whatever can be traced. 4. Lastly, no common receptacle is to be found.

§ 347.

Compound flowers become full in a peculiar manner. *Flores semiflosculosi,* when they grow mature, have a very long germen and a pappus, which is as long again as the germen. The linguiform corol, style, and stamens are natural, but the stigma is divided, and of the same length with the corol. Such deformities occur in Scorzonera, Lapsana, and Tragopogon.

By these characters, and by their never bearing ripe seeds, they may be distinguished from natural semifloscular flowers.

§ 348.

Flores radiati. Radiate flowers grow full in a twofold manner, either by the disk or centre, *(discus)*, or by the rays, *(radii)*. If the disk is full, it suppresses the radii altogether, and the tubular corols grow longer, so as to get almost a club-shaped form, and in this case the stamens are entirely lost; *e. g.* Matricaria, Bellis, Tagetes, &c. In the same manner, likewise, compound flowers become full, which naturally consist of tubular florets, for instance, Carduus.

From natural flowers of the same external appearance, full flowers may be easily distinguished by the longer corol, and by the want of seeds.

If the radius is full, then no disk can be seen, and such a flower gets much of the appearance of the flos semiflosculosus, from which, however, it may be distinguished at once, by there being not the least appearance of stamens. From the simple full flower the full compound flower differs in this point, that there is a style attached to each petal. The radius of a simple radiate flower remains the same in a full radiate flower. If the radius is beset with prolific female flowers, then the full flower, consisting of mere linguiform flowers, is provided with prolific styles, and may without difficulty, if there be any natural plants in its neigbourhood, come to bear ripe seeds. If the radius, on the contrary, consists of barren female flowers, we commonly find them to be the same in the full flower.

§ 349.

Flos difformis, the difformed flower, is not a full, but a barren flower, which in its appearance is unlike the natural plant. It occurs most commonly in monopetalous flowers. Some of the labiate and ringent plants especially, belong to this kind, for instance, Ajuga, Mimulus and Antirrhinum. They grow sometimes longer than usual, assume the form of egg-shaped corols, which are narrower at the top, and divided into four lobes: several long spurs are protruded from their base, which in these flowers are distinguished by the particular name of *Peloria*. The Antirrhinum *Linaria* very often affords this variety.

Another species of difformed flower is the Snowball, (Viburnum *Opulus*). This shrub has, in its natural state, small campanulate flowers, which on their margin are surrounded by large, unfertile, and rotate flowers. In gardens and in rich soil, all the flowers grow into large rotate corols, which are three times the size of the natural corols. All the stamens and styles vanish of course.

Another kind of deformed flower has been observed, though extremely rare. In one of the Umbellatae, just beneath the umbella, a compound flower was found resembling that of Bellis *perennis.* (Cf. Botanical Magazine, 1. Plate 2.) A flower like this was found by Gesner on a Ranunculus, (Cf. *Joan. Gesner, Dissert. De Ranunculo bellidifloro,* Tiguri. 1753, 4°.) It is singular to find on the stem of a flowering ranunculus and of an umbella, the flower of the Bellis. Once it was thought, that the stems of both were grown together, and that the stem of the Bellis had grown and unfolded itself in the first like a grafted sprig. But late observations have shewn, that this flower is not the perfect flower of the Bellis *perennis,* but merely a congeries of many flowers of the ranunculus or umbella, imperfectly unfolded, which have retained their small size and yellow colour, and are inclosed in a number of whitish petals. Perhaps the bite of insects produces this deformity.

§ 350.

Flos prolifer. A proliferous flower is one flower contained within another. This mostly occurs in full flowers. They are of a double kind; first, in simple and in compound flowers.

In simple flowers, a stem rises from the pistil, which buds and flowers. This stem is scarcely ever covered with leaves, and seldom more than one flower grows from another. Instances of this kind are, the pinclove, the ranunculus, anemone, roses, the Geum *rivale,* and Cardamine *pratensis.*

The deformity, however, is of a different kind in compound flowers. For in them a number of stems rise from the receptacle, which all bear flowers. Instances of this deformity are, Scabiosa, Bellis, Calendula and Hieracium.

In the Umbellatae something similar has likewise been observed, to wit, one umbel growing out of the other, or, what I once myself saw in Heracleum *Sphondylium*, the tall stem had on its extreme points green leaves and small umbels.

Proliferous flowers are a great curiosity, but they never have perfect seeds. I saw it only once in a lemon, on the apex of which a stem rose with another lemon. I doubt indeed if there be any proliferous fruits, the lemon excepted.

In such fruits, however, when the common receptacle grows larger, an appearance like that of proliferous fruits is often met with. I have repeatedly observed, in the Pinus *Larix*, a proliferous strobilus. I have even seen a strobilus which produced a sprig, on which other strobili were formed. In the same manner proliferous spikes are formed in rich soil, in Secale *cereale*, Phleum *pratense*, Alopecurus *pratensis*, and the like.

351.

A very remarkable monstrosity in the germen is, the *Clavus* in grain. The seed becomes swelled three times its usual size and thickness, but has no corcle. The clavus arises in the species of corn and gramina from an unknown cause, by a stagnation of the adducent and air vessels. There are two distinct species of it:

1. The simple clavus, which is of a pale violet colour, in its interior is whitish and mealy, without any smell or taste, and may be ground along with the sound grain, without any bad effects on the last.

2. The malignant clavus, which is dark violet, blue or blackish, internally has a blueish gray colour, a foetid smell, and a sharp pungent taste. Its meal is tenacious, imbibes warm water slowly, and has no slimy appearance when kneaded. The bread has a violet blue colour. When eaten, cramps, and especially the Raphania of Cullen are produced by it.

§ 352.

Sterilitas. We call plants sterile or barren, when they produce neither flowers nor fruits. All full, deformed, and proliferous flowers, therefore, are sterile, because the stamens and pistil suffer in them. But some plants are sterile only as far as they do not produce blossoms. The cause of this may be climate, too much sap, improper soils, and ill treatment. Plants, which are transplanted from a warmer climate into a colder, bloom very rarely. An artificial degree of heat, like their natural, is therefore frequently tried, but not always with good effect. The plants from the Cape of Good Hope require more warmth in winter than in summer, and if they have this are sure to blossom. Fruit trees, when they have too much sap, and their outer bark is too thick, have only a thin vascular ring annually formed; the sap therefore must ascend towards the top and the boughs, and fruit-trees of that kind grow often without ever having blossoms. Gardeners try to remedy this, by lopping some boughs, cutting off part of the root, and by removing the plant to a sterile soil; but they are, notwithstanding all these precautions, often disappointed. The best and easiest method is to bleed or scarify such trees, as it has been called, or to scratch superficially, and and in a winding direction, their stem and principal branches. The vascular rings are then at freedom to expand, and the tree will bloom and bear fruits without delay, as the circulation of the sap does not now go on with equal rapidity as before. Improper soil promotes sterility. If succulent plants, for instance, Cactus, Mesembryanthemum, be placed in rich garden earth, they may grow in it, but scarcely ever, at least very rarely, bear blossoms. Are they, however, placed in a ground mixed of loam and sand, then they will easily shew their blossoms, if they are rightly treated. Ill treatment indeed suppresses in many a plant the approaching flower. Amaryllis *formosissima*, if kept constantly in pots, filled with garden earth, produces many leaves, but no flowers. But, if its bulb be taken out and preserved in a dry place, out of ground, during the winter, a flower will appear every year. Many other bulbous plants, which grow in sandy plains in warm climates, do the same. Many examples might here be adduced, which for the sake of space, I am forced to omit.

§ 353.

Abortus. When flowering plants, which are provided with perfect female organs of generation, do not bear fruit. This originates from a want of male organs of generation, their bad structure, want of the impregnating insects, the heat of moisture and soil, sting of insects, and violent storms, various disorders, too great age and too much sap, or, lastly, when the flower appears at an unfavourable season. Every botanic garden can shew us numberless instances of abortion. How often do we lose exotic plants, bearing no seeds, because the male organs are either wanting, or in an imperfect state! How often might insects, could we obtain proper species, do this office! In this case, a great deal may be done by the gardener. If there is not sufficient warmth, which is required, to ripen many foreign fruits, they must necessarily drop off in its immature state. Drought and sterile soil not unfrequently deprive us of the fruit which we expected. Careful watering may assist us here greatly. The larvæ of various insects, and often these themselves, when perfect, rot and destroy the fruit. Winds, old age, and accidents, often disappoint our hopes of gathering fruit. Here no remedies are of avail, except avoiding the occasional causes. From too great a quantity of sap, many a fruit-tree throws off its fruits. This happens from the same cause that plants do not blossom for superabundance of sap, and the means above recommended in that case may serve us here as well. Most bulbous plants.

when the sap accumulates, drop their immature fruit. They should therefore be planted in dry ground. Some bulbous plants indeed only then ripen their seeds, if their unripe fruit be cut off with the stem, and kept thus lying for some time.

If a plant which requires particularly fresh air and insects, blossom in the middle of winter, or, to speak more generally, in a cold season, fruit will seldom be produced. In this case, nothing can be done, unless, indeed, by some artificial mode of treatment, the plant be made to blossom again in spring or summer.

VII. HISTORY OF PLANTS.

§ 354.

By the History of Plants, is to be understood the influence of Climate on Vegetation; the changes which it is probable plants undergo from the revolutions of our globe; their dispersion over its surface; their migrations; and, lastly, the means pursued by Nature for their preservation.

§ 355.

Geographers have imagined this globe to be surrounded by certain Zones, and they have divided these into degrees and circles. They suppose the hottest climate to be under the line, or at the Equator; a hot climate under the Tropics; between these and the Polar circles, two different climates, a temperate and a cold; and, lastly, they consider, under the Polar Circle, a very cold climate to prevail.

Upon the whole, these divisions agree well enough together; but great differences are produced by mountains, vallies, rivers, marshes, woods, seas, and inequalities of surface; so that there are places which, according to the above divisions, ought to be warm, which are however temperate, or even cold, and vice versa. We must therefore distinguish between a physical and geographical climate. America and Asia are much colder in the same northern geographical latitude than our part of the world. Plants which in America grow under the 42d degree of northern latitude, bear in our climate the cold of 52°. The reason of this great difference seems to be the enormous swamps and woods of America, and the immense elevation of the land in Asia. Africa, under the Tropics, is incomparably warmer than Asia or America. The chains of mountains in these last countries, and the humidity of the vallies, moderate the great heats, while the burning sands, of which almost the whole of the African soil consists, increases the heat. The regions about the North Pole are much more temperate than those at the South Pole. Tierra del fuego lies under the 55th degree of Southern latitude, and has a much more inclement sky than prevails in Europe under the 60th. Mountains that raise themselves high above the clouds, have, in all latitudes, perennial snow upon their extremest summits. Cook found such a mountain in the Sandwich islands; and in America, the celebrated Andes have their tops covered with perpetual ice under the Tropics and the Line, while a constant summer is felt in the vallies.

§ 356.

Situation, heat and cold, wet and dry soils, have great influence on the whole of vegetation. It is not therefore surprising to find, in every region of the globe, plants adapted to each particular situation. Accordingly, when we meet on the tops of high mountains the plants of Polar regions, we infer that these plants were destined for cold climates: nor ought we to wonder that, under the same latitudes in Asia, Africa, and America, we find, on similar soils, plants which are native in all these quarters of the globe.

In one geographical latitude, if no mountains or other circumstances change the temperature, the same plants are found to grow; but places in the same longitude, must always exhibit various productions of the vegetable kingdom. The Mark of Brandenburgh, the coasts of Labrador and Kamtschatka, lie nearly under the same latitude, and produce therefore many plants in common. Berlin, Venice, Tripoli, and Angola, are nearly in the same longitude; but their plants are very different.

§ 357.

It is well known that warmth is necessary to vegetation: hence it naturally follows, that in the warmer climates, the number of native plants will be most considerable. The Floras, made by Botanists in different countries, shew, that vegetation increases according to the degree of heat. In Southern Georgia, by the best accounts, there are only two native plants: in Spitzbergen, there are 30: in Lapland, 534: in Iceland, 553: in Sweden, 1299: in the Mark of Brandenburg, 2000: in Piedmont, 2800: on the coast of Coromandel, nearly 4000: as many in the island of Jamaica: in Madagascar, above 5000. In every region there are plants, except in the regions round the pole covered with perpetual snow, on the icy tops of the highest mountains, and in the dry and sandy wastes of Africa. On the bare and barren places where volcanic fires predominate, there are to be found few plants and those miserably stunted; as in the island of Ascension and Kerguelen's land.

§ 358.

Climate influences the growth, as well as the form, of every vegetable product. The plants of the Polar regions, and of high mountains, are low, with very small and close set leaves, but with flowers proportionally large. The plants of Europe have no very showy flowers, and many of them are Catkins: the Asiatic climates are particularly rich in splendid flowers: the African plants have, for the most part, very succulent leaves and variegated flowers. American plants are remarkable for long smooth leaves, and the singular structure of their flowers and fruits. The plants of New Holland are distinguished by thin dry leaves, and a more compressed form. Those of the Archipelago in the Mediterranean Sea, are in general shrubby and prickly. The plants of Arabia are of a low and stunted growth. In the Canary islands, the most of the plants, and even genera that in other climates are herbaceous, become either shrubs or trees.

The resemblance between the trees and shrubs of northern Asia and America is remarkable, though the herbaceous and perennial plants of both those parts of the world have almost nothing in common, with respect to form. The following comparative list will make this apparent:

In northern Asia grow	*Corresponding Plants in North America.*
Acer *cappadocicum*	Acer *saccharinum.*
Acer *Pseudoplatanus*	Acer *montanum.*
Azalea *pontica*	Azalea *viscosa.*
Betula *davurica*	Betula *populifolia.*
Alnus *glutinosa*	Alnus *serrulata.*
Corylus *Colurna*	Corylus *rostrata.*
Cratægus *sanguinea*, Pall.	Cratægus *coccinea.*
Cornus *sanguinea*	Cornus *alba.*
Fagus *sylvatica*	Fagus *latifolia.*
Fagus *Castanea*	Fagus *pumila.*
Juniperus *lycia*	Juniperus *virginiana.*
Liquidambar *imberbe*	Liquidambar *styraciflua.*
Morus *nigra*	Morus *rubra.*
Lonicera *Periclymenum*	Lonicera *sempervirens.*
Pinus *sylvestris*	Pinus *inops.*
Pinus *Cembra*	Pinus *Strobus.*
Platanus *orientalis*	Platanus *occidentalis.*
Prunus *Laurocerasus*	Prunus *caroliniana.*
Rhododendron *ponticum*	Rhododendron *punctatum.*
Rhus *Coriaria*	Rhus *typhinum.*
Ribes *nigrum*	Ribes *floridum.*
Rubus *fruticosus*	Rubus *occidentalis.*
Sambucus *nigra*	Sambucus *canadensis.*
Styrax *officinale*	Styrax *lævigatum.*

In northern Asia grow	*Corresponding Plants in North America.*
Thuya *orientalis*	Thuya *occidentalis.*
Tilia *europaea*	Tilia *americana.*
Ulmus *pumila*	Ulmus *americana.*
Viburnum *orientale*	Viburnum *acerifolium,*

&c. &c.

Between the shrubs of the Cape of Good Hope and those of New Holland, there is likewise a great resemblance. May we not suppose an agreement in respect of soil or situation, at the creation of organic bodies, to have produced the resemblance which we here discover?

In cold climates, the plants of the class Cryptogamia are most numerous; there are some tetradynamious, umbelliferous and syngenesious plants; but few trees or shrubs.

In warm climates are found most trees and shrubs, many Filices, twining, parasitical, succulent, and liliaceous plants, Bananas and Palms. Herbaceous and annual plants vegetate only in the rainy season. Those with pinnated and strongly veined leaves are found chiefly in tropical countries.

Aquatic plants, while they remain under water, have their leaves finely divided; but when they rise above the surface of the water, the leaves become broad, rounder, and at the base more or less emarginated.

Plants that grow in elevated situations are the reverse, with respect to the form of their leaves, of those that grow in water. Their radical leaves are more or less intire; but the stem leaves, the higher they rise, are always the more minutely divided. Examples of this we have in the Scabiosa *Columbaria*, Valeriana, &c.

§ 359.

Plants in their wild state remain pretty constant in their appearance, though they vary sometimes; but these variations are inconsiderable, in comparison of what they undergo when they become objects of culture. It is remarkable, that both plants and animals are no sooner domesticated than they begin to change their shape, their colour and taste. Alpine plants, or those of the polar regions, become, in vallies or gardens, very much larger; their leaves increase in length and breadth, but their flowers grow smaller, or at least do not increase. The plants of warm countries have so different an appearance from that they have with us, that an inexperienced botanist does not know them in their native places. How endless are the varieties we find in our orchards and kitchen gardens!

§ 360.

Now, whence comes the great number of distinct plants which our earth produces? Were these all created originally, or have new species appeared since, in consequence of mixture with one another? It is difficult to give a satisfactory answer to these questions. Linnæus, and some other botanists have supposed, that nature originally formed nothing but genera, and that the species were produced afterwards by the mixture of these. This hypothesis, however, seems untenable. In our days, we ought to see new species formed by the mixture of various genera, and experiments would confirm the fact. If it was possible for the infinite power which called every thing into existence to create genera, why should it not also have formed species? We find too much harmony, too much uniformity in nature, and see so much consistency in the machinery of it, to doubt that the wise creator of the whole did not give at the beginning to all organized bodies the forms we now see them in. Many genera of plants, however, of which in some countries there are very numerous species, may perhaps, by mixture, have produced a new one. We find, for instance, at the Cape of Good Hope, of the genus Erica, nearly 200 species, of Stapelia above 50, of Ixia and Gladiolus 58, of Protea above 70, of Mesembryanthemum about 180, not to mention other genera which likewise contain numerous species. The great resemblance between some of these, which makes it difficult to find characters to distinguish them by, gives some colour to the supposition.

We have already mentioned, (§ 301) that fertile hybrids are not uncommon in the vegetable kingdom. We find this occurrence in our gardens, and cannot deny that it may sometimes happen in the fields. Nature, however, has wisely provided, that in a wild state an intimate mixture cannot easily take place in plants. Those that nearly resemble one another, we find growing in very distant regions, flowering at different times, or placed in dissimilar situations. It is only congenerous plants that can mix and produce hybrids; nor can even that happen, unless many species of a genus grow in a given spot. Let us give an example of this position. We have, in this neighbourhood, three species of Scrophularia growing wild; namely, the Scrophularia *verna*, *nodosa*, and *aquatica*. The first grows about the villages in hedges, and flowers in the spring; the second is found in moist pastures, and flowers a month later: the third grows in rivers, marshes and ponds, and flowers a month later than the second. Other species of this genus, which resemble the above, grow in Italy, Siberia, in the East, in North America, &c. By none of these can any spurious brood be produced in their native situations. But if we bring all the foreign and indigenous species of the genus together, and place them in a Botanic Garden, would it be surprising if, in a soil to which they are not accustomed, some should flower sooner and some later than is natural to them, and by the additional means of the insect tribe, flying from one to another loaden with impregnating pollen, a hybrid should appear among them? We shall soon find a number of plants that never originally grew wild, but owe their existence solely to Botanic Gardens.

The numerous varieties of our fruits have certainly had their origin in this spurious method of impregnation, and perhaps some that pass for species have been produced in the same way. To me, it seems not improbable that Pyrus *dioica*, *Pollveria*, and *prunifolia*, owe their existence to such mixtures.

§ 361.

But were it even doubtful whether new plants were ever produced by mixture, we have perhaps a still more important conclusion to draw from the observations every day made, that great changes have formerly taken place in our globe, and much wreck been made of its vegetable produce.

The plains and secondary mountains, contain within them a large quantity of petrified bones, shells and animals. In schistus and sand-stone, there are impressions of various plants. These all proclaim the revolutions which our globe has undergone. But how was this powerful catastrophe brought about, or when did it happen? To these questions we want proofs to enable us to return a satisfactory answer, and must be content to confess our ignorance.

Meanwhile, however, naturalists have not been idle. They have carefully collected the remarkable symbols of former times, and compared them with the organic productions of the present. At first they expected to find many of these again; but they were unable to explain how it was possible for the Elephant, the Rhinoceros, and Hippopotamus to live and prosper in our climates, and in the cold of Siberia; or how Palms and various Filices could inhabit our northern regions. They endeavoured by many an ingenious hypothesis to account for this; but some of these were contradicted by the discovery of new petrifactions, and others had so little probability, that they went counter to all the known laws of nature.

Enquirers, however, were at last convinced, by many observations, that the petrified remains of animals, as well as the impressions of plants, belonged to subjects not now to be found alive on our globe.

Cuvier possesses a number of the remains of quadrupeds which do not now exist. By Conchology we learn that those bivalve shells, which are found in a petrified state, are never to be met with recent: and the beautiful Filices we see in schistus, the trunks of trees which are changed into coal, or petrified wood, even in the frigid zones, where cold suffers no tree to grow, are now no where to be found in a living state.

Accordingly, the most celebrated naturalists, as Blumenbach, Batsch, Lichtenberg and Cuvier, with many others, have drawn this highly probable conclusion, that at least one creation has been lost, and that the present organic world is a new formation.

They leave to the Natural philosopher, and Astronomer to account for these stupendous phenome na; but they believe that, perhaps the brilliant nim bus of the Sun, to whose benign influence we are so much indebted, may at long intervals be increased or diminished, nay, in certain periodical and stated times, be intirely extinguished; and that then, as at first, by the returning splendour of the Sun, acting on the ruins of the former creation, and the fermentation of the elements, another new one may arise. The periodical brightness and faintness of the light of some of the fixed stars, and the total disappearance of some of them which once shone with great splendour, seem to confirm the above opinion.

But though these remains of pristine animals and plants, have been preserved to our times, still it is certain that their originals are not now to be found; and that our chronology is not sufficient to ascertain the period when changes so eventful have taken place.

§ 362.

With respect to the plants at present existing on our globe, experience shews that mountainous places are richer in vegetables than plains, and that where there are primitive mountains, the number of plants is more considerable than on secondary mountains. A country where there are primitive mountains, has peculiar plants, which are wanting where there are no such mountains. We find upon all plains in the same latitude, however extensive they may be, the same plants without any other difference, than what arises from the difference of soils. Upon the primary mountains, and at their feet we meet again with all the plants of the plains. We find where high chains of the primary mountains skirt the plains, that all the plants of the plain are found at the bottom, and even up their sides. If we pass over the mountain and come to a new plain, another vegetation appears, which we again find at the feet of the succeeding chain. From the enumeration of plants made in different countries of Europe, and of other regions, we find this abundantly proved. Who then can doubt that the plants of all valleys have been derived from high mountains, and that the primary ones of our globe are the source of the Floras of every different country? Hence it is that America abounds so much in plants, being intersected from the North to the South Pole, by high chains of mountains with their numerous branches. Hence Canada produces other plants than Pensylvania, this others than Virginia, this again others than Carolina, and Carolina others than Florida, and so forth. Hence it is that the North-west coast of America nourishes very different plants from the North-east coast, the South-west coast different plants from the South-east coast. Islands that are flat, have all the plants of the neighbouring continents; but if they contain high mountains, they are not unfurnished with the plants that grow on those.

Thus, though according to these observations no great changes had happened to the plants at present existing, every hypothesis that should maintain the remains of the vegetable kingdom to be still existing plants, would be destitute of probability.

§ 363.

May not the sea have formerly been more extended over the globe than it is at present? Perhaps the earth consisted at first of a vast watery plain, broken only by chains of high mountains, and the depth of the sea might be smaller. On these mountains existed the vegetation of the present land. The sea might chuse itself a deeper bed, the mountain would decrease and the firm land by degrees appear, which would gradually be sown with the plants of the mountains and the vallies. Here and there the sea might leave large lakes of salt water, which would gradually dry up, and leave behind the hard rock salt. This bed of salt would, according to circumstances, by the waves of the sea or by high winds, be covered with earth, or with mud convertible into hard stone. The shore of the sea nourishes, as is well known, its own peculiar plants, which flourish in a soil abounding with salt, but perish where there is none. In the neighbourhood of these beds of salt, the shore plants would find sufficient nourishment and increase. Subterraneous springs of fresh water would flow over these salt beds, and being impregnated with the fossil would appear as salt springs. The shore plants would here find plenty of nourishment, and would propagate rapidly. This appears to be the origin of salt springs, and perhaps accounts for the appearance of the shore plants in their neighbourhood. We accordingly find near salt springs, in the interior of Continents, the following plants of the sea shore, which are no where else to be met with, viz. Salicornia *herbacea*, Poa *distans*, Plantago *maritima*, *subulata*, Glaux *maritima*, Samolus *Valerandi*, Aster *Tripolium*, *acris*, and many others.

§ 364.

When in this way, perhaps after a long succession of years, as we suppose, the land was gradually formed, hurricanes, earthquakes and volcanoes might again destroy large tracts, and change the form of the land, by which means a number of plants might be destroyed that afterwards might never appear again. We find most plants growing in their native places plentifully; but there are some, as may be inferred from what is just said, that have never been found but on one particular spot. For instance, Thunberg found on the Table mountain, at the Cape of Good Hope, and in one place only, the Disa *longicornis*, and Serapias *tabularis*, and never afterwards observed them elsewhere. Tournefort gathered from a single rock of the small island Amorgos in the Archipelago of the Mediterranean, the Origanum *Tournefortii*. Sibthorp, who made the same journey long after him, found that plant no where except on that very spot.

Countries that are now separated by the ocean might formerly have been joined, at least the plants they have in common, authorize the supposition. In this way might the most northern part of America have been connected with Europe, and New Holland with the Cape of Good Hope; thus too the island of Norfolk might have been joined to New Zealand, &c. For North America produces several of the smaller European plants, and in New Holland grow some of the plants peculiar to the Cape of Good Hope. In like manner New Zealand, which has a Flora quite different from that of the neighbouring continent of New Holland, possesses most of the plants that are found on Norfolk island, particularly the New Zealand flax, Phormium *tenax*.

Of this more examples might be produced if we had room for them.

§ 365.

Besides the manner in which we have said it is probable that plants have been dispersed over the globe, there are other circumstances that have contributed to spread some plants to a distance they would not otherwise have reached. Many seeds are furnished with hooked prickles, which take hold of the hair of animals, and are thus transported to a distance. Birds go in search of various seeds, and drop them often many miles off. The seeds of many aquatic plants cling to the feathers of birds that frequent the waters, and quit them when they alight in places far remote.

The seeds of most plants when perfectly ripe sink to the bottom in water. If they are contained in a hard shell they remain a long time fresh. Some feet deep under ground, and at the bottom of the sea, some plants will remain long in a state fit for vegetation. At these depths no air can reach them, and protected from the access of this, they are not destroyed.

It appears too that rivers and seas may transport plants to far distant places. Ripe and fresh seeds from the West Indies are sometimes thrown on the shores of Norway. Were the climate of that country fit for such plants, Coco nuts and other plants of the torrid zone would be planted and prosper. The seeds of the service tree are carried to remote places by our rivers. Many German plants have been observed on the coasts of Sweden, many Spanish and French on the shores of Britain many, African and Asiatic on the shores of Italy.

The wind carries the seeds that are furnished with down, with wings or membranaceous rims, as also those that have swollen capsules, to places convenient for their germination. By this means too, some plants that have light seeds are scattered in the tract of the prevailing winds, and carried to places they would not otherwise have reached. The wind carries the winged seeds of the Birch, (Betula *alba*), to the tops of towers and high rocks where they often germinate. The Birch is likewise by reason of its light seeds dispersed over northern Asia, whither the heavy acorns of the Oak, (Quercus *Robur*), cannot follow them.

Many seed-capsules and fruits burst with an elastic force, and scatter their seeds round about, while others are obliged to remain in the places where they are produced, particularly such as ripen under ground. The pistillum of some plants, after flowering, turns down, and pushes itself into the earth, where the seeds come to perfection. Examples of this are found in Arachis *hypogaea*, Glycine *subterranea*, Trifolium *subterraneum*, Lathyrus *amphicarpos*, Vicia *subterranea*, Cyclamen, &c. Berries, and all succulent fruits cannot disperse themselves; they fall to the ground, and their soft skins nourish the young plant. Many birds and other animals feed on these; they carry them away, and having eaten the succulent part, let the seeds drop, or the seeds pass uninjured through their intestinal canal, and are thus propagated. In this way the Misletoe, (Viscum *album)*, is sown by a bird, the Missel-thrush, (Turdus *viscivorus)*, and thus also the Juniper (Juniperus *communis*).

But man himself has done more for the dispersion of plants than winds, or seas, or rivers, or animals. He whom all nature obeys, who changes the wilderness into fertile fields, who lays waste whole countries and again restores them, has, in various ways, promoted the dispersion of plants.

The wars which nations wage with one another; the migrations of different people; the pilgrimages to Palestine; the travels of merchants, and trade itself, have brought to us great numbers of new plants, and have carried our plants to many distant regions. Almost all our garden vegetables have been brought from Italy and the East; and the most of our grains have come to us from the same quarter. By the discovery of America we have received different vegetables, which formerly were unknown to us, but which are now common.

The thorn-apple (Datura *Stramonium)*, that is now known over almost all Europe, the cold countries of Sweden, Lapland and Russia excepted, as a poisonous plant, was brought to us from the East Indies, and was so generally dispersed, by means of Gypsies, who used the seeds of it medicinally as an emetic and cathartic.

The kidney-bean, (Phaseolus *vulgaris)*, the Phaseolus *nanus*, Impatiens *Balsamina*, and the Panicum *miliaceum* (millet) were likewise brought from the East Indies.

Buck-wheat, the most of our grains and pulse, have come to us from the East through Italy.

Apples, Pears, Plumbs, Cherries (Prunus *avium*), Medlars (Mespilus *germanica*), Crataegus *torminalis*, and the hazel nut, are originally German plants. In warmer countries, they are, however, much more delicious. The numerous varieties of these to be found in our gardens we have received from Italy, Greece and the Levant.

The horse-chesnut, (Aesculus *Hippocastanum*), according to Clusius, came to Europe from the North of Asia in the year 1550. The Crown Imperial, (Fritillaria *imperialis*), we received first from Constantinople, in the year 1570.

After the discovery of America, many plants from that country have been naturalized in this. The potatoe was first described in 1590, by Caspar Bauhin; and Sir Walter Raleigh, in the year 1623, brought it first from Virginia to Ireland, whence it has been distributed over the whole of Europe.

The Oenothera *biennis* was first introduced by the French, on account of its esculent root, in 1674; since which time it has grown so common, that it grows wild in almost every country of Europe in hedges and about the villages.

Tobacco (Nicotiana *Tabacum*), was first described by Conrad Gesner in 1584. In the year 1560 it was brought to Spain, and in 1564, to France by Nicot, a French ambassador.

Colewörts and other plants of that sort were brought from Greece to Rome, whence they were spread over all Italy, and at length reached us. It would be tedious to trace the migrations of all the cultivated plants at present in use. It is sufficient to mention a few of them.

With the different kinds of corn, likewise, many plants have been introduced, which are now naturalized. Such as, the blue bottle, (Centaurea *Cyanus)*, the corn-cockle, (Agrostemma *Githago)*, the wild Radish (Raphanus *Raphanistrum)*, the common Myagrum (Myagrum *sativum*), and many others. These plants are only found among corn, and are never seen on waste places where there are no corn-fields. In the same way, at the introduction into Italy of Rice, (Oryza *sativa)*, from the East Indies, many plants have been observed that grow only amidst the Rice. This plant was first raised in Italy in 1696.

The Europeans, in establishing colonies in various parts of the world, have carried along with them all our culinary plants. By this means many European vegetables have been introduced into Asia, Africa and America, and where the climate would allow it, have spread themselves over these countries.

§ 366.

Nature is always busy in making one plant take advantage of the protection of another; she likewise provides for the propagation of seeds in many various ways. Lichens and mosses are destined for this purpose in cold climates, the rainy season in tropical countries, and storms and changes of weather in the polar regions. In our climate, besides lichens and mosses, there are commonly three tempestuous periods that assist the dispersion of seeds and plants, namely in Spring, in the middle of Summer, and in Autumn. These, besides the important purpose of purifying the atmosphere, have one of great advantage to the vegetable kingdom. In Spring they dispose the seeds that have continued through the Winter to hang on the stems of plants: in the middle of Summer they carry to a distance those that have grown ripe in the Spring, and in Harvest those that have come to perfection in Summer. Moles and dew-worms and earth-worms, having perforated the soil and fitted it for the reception of these seeds, a heavy rain forces them into it, and, by the benign influence of the Sun's rays, at the proper period they germinate. It is easy to imagine, that, in this way, many seeds may be brought to places which are not fit for their reception, and thus perish: On this account the wise Author of Nature has provided the annual plants with a much greater number of seeds than would otherwise have been necessary. A single plant of Turkey corn (Zea *Mays)*, bears 3000 seeds; the Sun-flower, (Helianthus *annuus*), 4000; the Poppy (Papaver *somniferum)*, 32,000, and Tobacco (Nicotiana *Tabacum)*, 40,320; but of so great a number some must necessarily fall on convenient places and be propagated.

Naked rocky places, on which nothing can grow, are, by the winds, covered with the seeds of Lichens, that by means of the accustomed showers in Harvest and Spring are induced to germinate. Here they grow, and the rock is spotted with their coloured frond. In time the winds and weather deposit small dust in the rough interstices of the rock, and even the decaying lichens leave a thin scurf. On this meagre soil the seeds of mosses are accidentally driven, where they germinate. They grow and produce a pleasant green tuft, which, in time, is fit for the reception of the smaller plants. By the rotting of the mosses and small plants, there arises a thin layer of earth, that in course of time increases, and then becomes fit for the growth of various shrubs and trees, till at last, after many years, where formerly there was nothing but naked rocks, the eye of the traveller is gratified with the sight of extensive woods of the most beautiful trees. Such is the process of Nature! Gradual, great, and constantly conducive to general good are her operations. Mosses and Lichens improve in a similar manner the dry and barren sands. The plants that grow naturally in such soils have almost all creeping and extensively penetrating roots; or they are succulent, and draw moisture from the atmosphere. By means of these plants the sandy soil is made fit for the reception of mosses and lichens, and afterwards changed into good and fertile earth.

Mosses cover the stems and roots of trees: they have this particular property, that in warm weather they wither, and in wet weather revive again. They readily attract moisture and maintain themselves in the rugged interstices of the bark. From the tree they draw no nourishment; this they receive intirely from the atmosphere. In winter they protect the tree from cold, in wet weather from corruption, and in dry weather, they impart to it their moisture, and they protect the stem and the root from the burning rays of the Sun*.

But the use of mosses is greater still. In them plants and trees will grow as well as in the best garden soil. Gleditsch brought many fruit trees to perfection in mosses alone. Some kinds of mosses grow chiefly in wet and marshy places, as the turf moss (Sphagnum *palustre).* Stagnant waters and ponds have their surfaces covered with them, and are afterwards, by the marshy plants, that grow there, converted into meadows and fields. According to Tacitus, the whole Hercynian forest was once a marsh, though now, in the places described by him, there are fertile fields and meadows. Aged husbandmen in our neighbourhood can remember places, where formerly there was nothing but stagnant water, which are now converted into fertile fields, and rich meadows.

The property of mosses to attract moisture occassions their growing most plentifully in wet places. The tops of mountains are covered with a profusion of them, which draw towards them the moisture of the clouds; the clouds thus attracted, and in which the tops of mountains are almost constantly involved, prevent their being able to retain all the moisture,

* Mosses and Lichens, are prejudicial only to young trees where the bark is still active; but mosses, when they are very long, may, by retaining a superabundance of moisture, be hurtful even to grown trees.

which therefore sinks into the clefts and crevices, whence it proceeds from all sides to the lowest place, and at last appears in the form of a spring. Many small springs unite and form a rivulet, which in its progress swells to the size of a large stream. Thus to the apparently insignificant mosses, are we indebted almost intirely for the mightiest rivers, and to them moreover do we owe the desiccation of extensive swamps, and the fertility of the most unfruitful soils.

The object of nature is not only the maintenance of every plant, but the turning to use even the decaying parts of every vegetable and animal production. The smallest space is destined to be the abode either of a plant, or of an animal. The richest and most barren soil, the dry sand, the naked rock, the highest Alps, the deepest morass, the bottom of rivers, of ponds, and of the ocean, nay, the darkest cavities under ground, such as mines, produce their peculiar plants. Putrescent animal substances are attacked by mucors, and small fungi, which accelerate their destruction, and convert them into earth, to afford soil and nourishment to other plants. Thus the leaves, the stems, the wood, and different parts of vegetables become a prey to these destructive fungi, which complete the process of putrefaction. What appears to be nothing but desolation and death, is the theatre of a new world in miniature. Every created thing serves for the good of the whole.

§ 368.

The plants of fresh water are more widely dispersed than those of the land. Water moderates the heat and cold of climates, and hence many European aquatic plants grow also in warm countries. The common Duck-meat, (Lemna *minor)*, grows not only over all Europe and North America, but is found also in Asia. It has been observed in Pennsylvania, Carolina, Siberia, Tartary, Bucharia, China, Cochin-China, and Japan. The Bulrush, (Typha *latifolia)*, grows over Europe, North America, in Jamaica, in Siberia, China, and Bengal. The great number of water-fowl that yearly migrate, by a most wonderful instinct, from a colder country to a warmer, occasions the wider dispersion of aquatic plants. The most of these plants perfect their seeds at the season when the birds are preparing to set out on their journey. The seeds stick to the feathers, they are also sometimes swallowed by the birds, and afterwards passed without injury.

§ 369.

The plants that grow at the bottom of the sea are found in all regions, because the vicissitudes of heat and cold are never felt at the bottom, which is generally every where of the same temperature. The Fucus *natans*, a very common sea plant, and which goes by the name of Sargazo, or Sea-grass, is found as well under the Equator as under the Poles As the marine plants are very numerous, many of them are to be found every where, with this difference only, that some require a more concentrated saltness of the water or a moveable bottom. Others grow at different depths, and it is only on such as prefer shallow water that the climate has any influence. In general it is to be remarked that the heights or hills which are found under the surface of the ocean, are more productive of plants than the deep gulphs and valleys there.

§ 370.

The mountainous or alpine plants are nearly the same on all those chains which had formerly been connected but are now disjoined, and there are many that are common to different mountainous ridges, though each of these may again nourish its own proper plants. Nay the common alpine plants, that is, those that are found on the Alps of Europe and Asia, seem to follow the line of perpetual snow, and are met with on the plains in Greenland, Spitzbergen, Lapland, Nova Zembla, northern Siberia, and Kamtschatka, while in the warmer regions they keep on the summits of the highest Alps. On the mountains of Siberia, Lapland, Norway, Scotland, and Switzerland, on the Pyrenees, on the Apennine and Carpathian Alps, as well as on the smaller mountainous chains of Germany, as in the Hartz, in Thuringia, in Silesia, and Bohemia, there are many plants that are common. For instance, the dwarf Birch, (Betula *nana)*, is found on them all, the Siberian, Apennine, and Carpathian Alps excepted. May not this communion of some plants, which can only be dispersed by means of winds, of birds, and other circumstances, be a proof of a former connexion? Tournefort saw at the foot of the mountain Ararat, the plants of Armenia, higher up those common in France, still higher those of Sweden, and at the top the alpine plants, which are found at the North Pole. Similar observations have been made, by other travellers, on mount Caucasus.

On the mountains of Jamaica Swartz found no European alpine plants, but many common European mosses, such as Funaria *hygrometrica*, Bryum *serpyllifolium*, *caespititium*, Sphagnum *palustre*, Dicranum *glaucum*, and many others. We know that the seeds of mosses are so small as to be invisible to our eyes, and that it requires a high magnifier to enable us to see them. We know too that they swim in the air; may they not, therefore, have been driven thither by the winds, and, finding a convenient climate, have there generated? at least no other way of accounting for their appearance occurs to me.

Perhaps the seeds of some Lichens that grow in warm climates may be brought by the winds to us, and by reason of our unfavourable climate grow, but bear no fruit. This appears to be the case with the Lichen *caperatus*, which is found in the south of Europe, as in Provence, Italy, &c. on the stems of the Olive trees, and on the stakes that serve for the support of the vines, and almost never without the fructification; while with us, where it is so common, it never bears any.

But when the two Forsters found on Tierra del Fuego, the Pinguicula *alpina*, Galium *Aparine*, Statice *Armeria*, and Ranunculus *lapponicus*, they might well find it difficult to say how these plants arrived at the furthest corner of the world. It may be questioned, therefore, whether the great resemblance, that these plants bore to those of Europe, did not mislead our great naturalists, in taking them for the same, as they might have distinguishing characters which, for want of comparing them with the European species, they did not suppose. When Linnaeus and other botanists state varieties of a plant to exist in different zones, they are not always to be trusted; for I have often seen that such varieties had more constant characters than many which are by them made species, and that they really did constitute true species. Why should not Nature, in different degrees of latitude and longitude, have formed species that exceedingly resemble one another?

§ 371.

In all countries there occurs a remarkable circumstance in the history of plants, namely, that some grow gregariously, and some single; that is, some always grow numerously and close together, while others are scattered and lead a sort of retired life. The reason of this singular circumstance appears to lie in the seeds themselves, which are either too heavy for the wind to carry away, or too light so as to be destroyed by it, or the elasticity of the capsule is not strong enough to throw them to a distance. The root too of some vegetables is creeping, so that many plants of such must always stand together.

The gregarious plants sometimes occupy great tracts of ground. The common heath, (Erica *vulgaris)*, extends often for many miles. The whortle-berry, (Vaccinium *Myrtillus)*, the straw-berry, (Fragaria *vesca)*, some species of Pyrola, various rushes, (Junci), and some trees are of this kind. Solitary plants are the Turritis *glabra*, Anthericum *Liliago*, Lychnis *dioica*, and many others. But when places are very populous, men have made great alterations in this respect, by planting woods, and bringing plants close together that would have stood separate, &c. The difference between gregarious and solitary plants is of consequence to those who generally do not regard it. We give here for instance mosses which the forester and the economist trouble themselves less about than they ought. Gregarious mosses are the Sphagnum *palustre*, Dicranum *glaucum*, Polytrichum *commune*, and many others. The solitary are, Polytrichum *piliferum*, all the species of Phascum, Weissia *paludosa, &c.*

§ 372.

Plants, like animals, are confined to certain latitudes. Many natives of warm countries can by degrees accustom themselves to our climate, and even to those that are colder. Under shrubs are more easily reconciled to a warm than to a cold or even a temperate climate. In high latitudes there falls at the beginning of winter a deep snow, that does not melt till the return of spring, after which no night frosts are to be expected, and the air of which is but a degree of temperature above the freezing point. In temperate climates it often freezes strongly without snow having previously fallen, and thus the plants are killed. By this means the Polar and Alpine plants, which in their native places are covered with snow, are frozen with us, where frosts without snow are frequent. It is only those undershrubs and annual plants of warm countries, which require a longer time for pushing their shoots and flowers than the short summer of a cold climate permits, that cannot here be inured to the open air, and those which require a great degree of heat.

But trees and shrubs seem to be more sensible of cold, because their perennial trunk is raised high above the ground, and thus sooner suffers by the vicissitudes of the weather. Some that are natives of warm climates have become naturalized with us, perhaps because their cellular texture is tougher than that of other plants; but, on the contrary, there are many, that in this respect are unaccommodating, because their organization will endure no great alternation of heat and cold.

But the most useful plants, like the domestic animals, are capable of succeeding in very different climates. If there are some which are confined to certain zones, there are others in those regions where these cannot live, to supply their places. Under the Equator and within the Tropics in similar situations our kinds of grain do not prosper; but, instead of them, there are the Rice, (Oryza *sativa),* Indian corn, (Holcus *Sorghum),* and Turkey corn, (Zea *Mays*), which are proper substitutes for our grain. In Iceland and Greenland neither our corn nor that of the tropical regions will grow; but nature has provided for these countries the Elymus *arenarius* in abundance, which in case of necessity may be used as Rye.

In no cold climate are there wanting esculent roots and pulse. Of these many grow wild which remain untried, but of which necessity, if we had not received our garden plants from the East, would have taught us the use. All our kitchen-garden plants are so obedient to the variations of climate, that they have followed the footsteps of men to almost every region.

§ 373.

From what has been said, it may naturally be inferred that, after so many and such various changes as plants are subject to, it cannot but be difficult to ascertain the exact point from which each has originated. We shall, however, endeavour to fix something with regard to those of our part of the world, because with these, particularly in the northern part of it, we are better acquainted than with others. As to Greece, we must pass it over, because in a botanical point of view it is almost wholly unknown to us. Its Flora, however, seems to originate in the Sardinian Alps, the coasts of Asia and Africa, and the islands of the Archipelago. According to our former position, plants have descended from the highest mountains to the plains, and we here assume five principal Floras for Europe, namely, the

Northern, the Helvetian, the Austrian, the Pyrenean, and the Apennine.

The Northern Flora proceeds from the Norwegian, the Swedish and the Lapland Alps. These nourish in common the plants of the high northern latitudes. The mountains of Scotland seem formerly to have been connected with those of Norway, for the same plants grow on both.

The Helvetian Flora takes its origin from the Swiss, the Bavarian and the Tyrolese Alps. The mountains of Dauphiny, and those of Bohemia and Silesia are only lateral branches of the same chain. All contain a great number of the same plants.

The Austrian Flora originates in the Austrian, the Carinthian and Steyermark Alps. The Carpathian make a part of the same chain.

The Pyrenean Flora arises in the Pyrenees. The mountains of Catalonia, Castile and Valentia are parts of them.

The Apennine Flora is derived from the Apennines, and these send off many secondary branches.

The Helvetian Flora takes up the greatest space. The whole of Germany, with exception of the Austrian circles and Moravia, Prussia, Poland, all France, except the southernmost part of it, the Netherlands and Holland produce the same plants.

The Northern Flora extends over Denmark, Sweden, and Russia, and partly over England.

The Austrian Flora stretches from the circle of Austria over Moravia, the southern part of Poland, Hungary, Moldavia, Wallachia, Bulgaria, Servia, Bosnia, Croatia, Sclavonia, Istria and Dalmatia.

The Pyrenean Flora occupies all Spain, the islands of Majorca and Minorca, perhaps also Portugal, but here our information fails.

The Apennine Flora extends over the whole of Italy, Sardinia, Corsica, and a part of Sicily.

If we make a Catalogue of the plants of these five different Floras, the local distribution of them will be very remarkable.

It is also easy to imagine that various mixtures of the different Floras must have taken place after the firm land was formed and settled. This is the reason why the south of France, where the Helvetian and Pyrenean Floras mingle, is so rich in plants; In Piedmont the Pyrenean, the Helvetian and the Apennine Floras meet, and thither also, by means of the sea, are the plants of the North of Africa brought. For the same reason Great Britain consists partly of the Northern and partly of the Helvetian Flora, and in Cornwall, the most southern point of the kingdom, the plants of the Pyrenean Flora, by means of the oblique position of the Spanish coast, are mixed with the others. Sweden, Denmark and Russia have not maintained the Northern Flora pure; many plants of the Helvetian have found their way thither. The same may be said of Germany, and particularly of our mark of Brandenburg, where, besides the Helvetian Flora, we have received a part of the Northern. From the Northern we have certainly acquired the Malaxis *Loeselii*, Neottia *repens*, Helonias *borealis*, Vaccinium *Oxycoccos*, Ledum *palustre*, Andromeda *polifolia*, Linnaea *borealis*, and many others : From the Helvetian Flora the following, Chironia *Centaurea*, Euphorbia *Cyparissias*, Cucubalus *Otites*, and the most of our plants.

It is very remarkable that two such common plants as the Euphorbia *Cyparissias* and Cucubalus *Otites* should disappear about twenty German miles from Berlin towards the North, and are not again to be met with, though they prosper perfectly well in the northern botanic gardens. Perhaps these plants will in time sow themselves further north, and proceed by degrees in the same direction. Who will say that they have not advanced in a greater degree during the last century, that many plants have not also extended themselves in the same way, and that the Flora of Berlin has not acquired new species in a course of years?

Plants that increase much by seed, and at the same time by the root, must be consequently the more widely dispersed ; it is not therefore surprising that several of these are found over all Europe, from one end of it to the other. Those plants too that have light seeds which the winds can easily bear away, are more easily disseminated than those whose seeds are heavy. Some plants therefore of the former description, have travelled from Lapland to the extremest point of Italy, nay, even to the North of Africa.

The northern parts of Asia possess many of the plants of Europe. We see towards the north, the Northern Flora, towards the South, the Austrian, and between these the Helvetian conspicuous. It would seem that the European mountains had been sooner provided with soil, and that this had been late in taking place on the Asiatic mountains, or that very little soil had covered the mountains on the North-west coast of Asia. It is no wonder then if, even to the Uralian and Altaic chains of mountains, the plains on this side have few Asiatic, but many European plants.

North America produces very many of the small European plants, which for the most part are those of the Northern Flora. It is therefore probable that at some former period, there had existed a connection between both the old and new worlds, which in later times has been broken.

§ 375.

In order to form a just idea of our proposition with respect to the dispersion of the vegetables of our globe, we must travel over all the high primitive Alps, collect the Flora of each particular mountain down to its bottom, and in the neighbouring vallies, but we must not descend into the plains. Were Europe investigated in this manner, we would be able to determine, according to the number of plants found existing there, how the dispersion must have happened, and how the plants of this or of that chain of mountains have found their way to the plains.

The sea shores do not always indicate the Flora of the interior. Upon the coasts we often find plants that have been brought from the neighbouring regions. For this reason Asia, Africa, and America within the tropics possess many plants in common, which they have obtained from the shores of the neighbouring countries. But if we travel farther into the interior of those parts of the world, these plants almost intirely disappear, and each of these portions of the globe exhibits to us its own indigenous productions, which are the more numerous, if many ranges of mountains, with a loose soil, be in the neighbourhood.

At the Cape of Good Hope, we see around a Flora so rich, so peculiar, and so little mixed, because the place itself is a mountainous region. Madagascar possesses a numerous Flora, because that large island is very mountainous, and two quarters of the world, namely, Africa and Asia, between which it lies, communicate to it their various productions. The Bahama islands are indebted for their rich Flora, to their own mountains and the neighbouring countries. We there find not only indigenous plants, but the most of those of Carolina, and Florida, and very many inhabitants of the West Indies and of the Mexican gulph.

§ 376.

To find a plant existing as indigenous in all latitudes would be difficult. Such plants as are found widely dispersed, have been planted by the hand of man. The Chickweed (Alsine *media),* which Linnaeus and others affirm to be found every where, is met with only in those places to which our culinary plants have been conveyed. I do not find it mentioned by the Indian botanists, although I believe it might grow in India; but in the warmer places of Africa, I doubt much if it would exist.

An extensive habitat has been assigned to the common Nightshade (Solanum *nigrum),* and the Strawberry (Fragaria *vesca).* But naturalists have taken similar plants for varieties of the common European species, and have ascribed to those mentioned a much more extensive residence than they really enjoy. The plants of the coasts have been more widely dispersed by nature, than those of the interior. Among these the Purslane (Portulaca *oleracea);* the Sow-thistle (Sonchus *oleraceus);* and the Cellery (Apium *graveoleus);* are the only ones that have wandered far: but even of these the two last have not been met with in the warmest regions of the globe.

I doubt, however, if among the numberless plants which our Earth produces, there may be any of so accommodating an organization as to endure every climate, as in the animal kingdom, man, the dog and hog do, which we know will prosper from the torrid to the frigid zones.

VIII. HISTORY OF THE SCIENCE.

§ 377.

Botany, as a branch of Natural History, has only lately attained that degree of perfection in which we now see it. Though the scientific knowledge of the ancients deserves great praise, yet they were very little acquainted with Natural History. A botanist of that time scarcely deserved the name. The whole knowledge of plants consisted in a few very undetermined names, merely preserved by tradition. However, as man soon after began to feel the necessity and the utility of a juster knowledge of nature, more attention was paid to this point. Great care especially was taken to give proper appellations to the different organic parts, and to direct the attention even of those who were not studying the science, to this important branch of natural knowledge. After the art of printing, so favourable for science, was invented, figures of plants began to be engraved. These first drawings of plants were only cut in wood. Plants which have a striking difference from others may easily be distinguished in this way;

but more delicate plants, which have some resemblance to others, will scarcely ever be distinctly enough represented by figures of that kind. The best we have are from Rudbeck, Clusius, C. Bauhin, and Dodonaeus. The art of engraving in copper, became soon very important for botany. It enabled philosophers to make the knowledge of plants of more general use. The neatest plates are those of Linnaeus in the Hortus *Cliffortianus*, of Smith, Cavanilles and L'Heritier. Some botanists gave engravings like cuts, representing only the outlines of the whole plant. Such we have in Plumier, and the works of the younger Linné. To procure plates in a still less expensive manner, some botanists put printer's ink upon plants, which were dried, and then threw off the impressions. Such representations are, no doubt, very accurate, but the finer parts of the flower are always entirely lost. The best impressions of that sort we have from Junghans and Hoppe. Of coloured plates those of Roxburgh, Masson, Smith, Sowerby, Trew, and Jacquin, are the best.

Of a botanist we require in our times an accurate and thorough knowledge of all wild growing plants, from the largest to the smallest moss; a complete knowledge of all the parts of a plant, and of the botanical terms; lastly, an intimate acquaintance with all the natural families of the vegetable kingdom, and with the properties, peculiarities, and different virtues of plants. In common life we give the name of a botanist to him, who gives us good representations of plants, and knows to distinguish some by their external characters. But the first has no merit whatever, and his work can only deserve our approbation as the production of an artist, if his drawings of plants are well executed. Nor can the other pass for a botanist, as he is unacquainted with the smaller plants, such as algae, mosses and fungi. It is not the simple knowledge of plants that makes the botanist. A botanist compares his plant with all known ones, looks for the distinguishing features, and observes attentively nature in general. Nomenclature alone can indeed never afford us real pleasure, whereas careful observations will furnish us with abundant facts for further investigation. The botanist likewise points out to the physician, farmer, forester, and artist, all useful plants, and without him they never can make any certain and just experiments.

The history of botany then shews us the gradual progress which man has made in the knowledge of the vegetable kingdom. To take a view of it with more facility, we shall divide it into several epochs.

§ 378.

FIRST EPOCH.

From the first origin of the Science till the time of BRUNFELS.

The first inhabitants of our globe were in the very beginning of their existence obliged to get acquainted with those fruits only, which sufficed to satisfy their moderate desires. Experience soon taught them, that some plants were very noxious to man. Only those and the few which they used as food, were known to them. But as soon as they began to disperse here and there, and to require more necessaries, they were obliged to seek for other aliments. Several diseases, the natural consequences of a violation of the laws of nature, obliged them to look for remedies, which they luckily discovered in the vegetable kingdom, either by accident, or through animals. Thus the inhabitants of Ceylon learned the use of Ophiorrhiza. A small animal, (Viverra *Ichneumon)*, which feeds on poisonous serpents, eats, as soon as bitten by one of them, the root of this plant. The Ceylonese having observed this, tried it, and found it an excellent remedy against such a bite. In like manner became the Americans acquainted with the use of Aristolochia *anguicida* and *Serpentaria*. Thus the knowledge of some medicinal plants commenced. The father shewed them to the son, the son to the grandson, and so forth. By tradition, the only means at those times of preserving things from oblivion, their names were communicated to the farthest generations.

In the East, at first the only seat of erudition, the greatest care was taken to acquire a knowledge of the beneficial or noxious qualities of different natural productions. The Chaldeans communicated their knowledge to the Egyptians, and these to the Greeks.

In Greece, where indeed real science first originated, Aesculapius attempted, by means derived from the vegetable kingdom, to cure some diseases. But medicine soon became intimately connected with religion. In the temples dedicated to the worship of the gods, the prescriptions of Aesculapius were publicly hung up, and the priests alone undertook the examination and the search of officinal plants, and the treatment of different diseases. They were, as followers of Aesculapius, called Asclepiades.

The father of medicine, Hippocrates, added to the observations of Aesculapius a great many of his own, and first published several works on medicine. In his writings, the diseased and the healthy state of man are very fully treated of, and in speaking of the methods of cure, he has mentioned about 234 plants. But these are only names. Hippocrates was born 459 years before Christ, at the island Cos. He lived to a very old age, though, as to that, authors differ, some saying he lived to be 89 years old, some 90, others 104, and a few indeed 109. The plants he mentions can scarcely be guessed at, for though great natural philosophers and linguists have attempted, long ago, to fix them properly, notwithstanding all those endeavours, they still remain very doubtful.

Cratevas or Cratejas, was a cotemporary of Hippocrates. Cratejas is said to have been very well acquainted with all the herbs and roots of Greece. His work, entitled Ῥιζοτομίκον, has been almost entirely lost, which is much to be regretted, because, most probably, the different plants mentioned in the cure of diseases by Hippocrates, were more accurately described by him. In the Imperial library at Vienna, as I am told, some single fragments of this work are still preserved.

Aristotle first undertook, at the expence of Alexander the Great, to write a complete natural history. This philosopher, however, has paid more attention to the other kingdoms of nature than to the vegetable kingdom. He lived soon after Hippocrates.

Theophrastus was born at Eresus, in the island of Lesbos, about 300 years before CHRIST. Though he lived upwards of 85 years, he still complained of the shortness of human life. He was a pupil of Plato and Aristotle, and so great a favourite of the last, that he became the heir of his library, and his successor in the peripatetic school. Of all those we have named, he was best acquainted with botany. In his work* he has given us the descriptions of more than 500 plants. They are, however, only officinal plants, the use of which he has very accurately explained.

The Romans, likewise, after their victory over Mithridates, began to study this branch of natural history.

Marcus Cato wrote, 149 years before CHRIST, on medicine, and the remedies used in it.

Marcus Terentius Varro lived at the time of the emperor Augustus, and wrote chiefly on country affairs.

Pedanius or Pedacius Dioscorides, born in Asia, at Anagarba in Cilicia, paid extreme attention to the investigation of the medical powers of the vegetable

* Περὶ φύτον ἱστορίας. There are a great many Latin translations of this work; the last is Theophrasti Eresii Historia Plantarum. Lib. IX. cum commentariis J. L. Scaligeri et J. Bodaei a Stapel. Amstel. 1644. fol.

kingdom. His work* contains the descriptions of more than 600 plants. He made many and extensive journeys through Asia. Dioscorides lived under the emperor Nero, 64 years after CHRIST.

Caius Plinius Secundus flourished at nearly the same time. He collected the most important passages on all parts of natural history, from the writings of his predecessors, but especially used the works of Dioscorides in his writings on plants. Pliny has made no discoveries himself. From his 11th to his 19th book he treats on plants. He says, strangely enough, that there are many more plants growing near hedges, public roads, and in fields, but that they have no names, and are of no use. In his 56th year he became the sacrifice of his curiosity and inquiries into the nature of things, attempting to witness an eruption of Vesuvius.

Several Roman authors wrote on plants, but what they have left are merely transcripts from other authors.

Except the works of some Asiatic writers, as Galenus, Oribasius, Paulus Aegineta, and a few other physicians, nothing more was written on the productions of the vegetable kingdom. And indeed even these authors give us nothing else but mere lists of names, which are of no use whatever.

* Περὶ ὕλης ἰατρικῆς, or De Materia medica, Lib. VI. It was first published by A. Manutius at Venice, 1499, in folio. Another edition was published with notes, by J. A. Saracenus, at Francfort, 1598, in folio. But we have been favoured by Van Swieten, at Vienna, 1770, with a very elegant edition with plates.

Soon after CHRIST several physicians, Mesue, Serapio Razis, Avicenna and others appeared in Arabia. But they mention only the officinal plants of older writers.

A long pause now happened, during which science was, as it were, entirely asleep. The few scattered writings on medicine and natural history were mere compilations from old authors, decorated with the pedantic learning of monasteries. Thus botany was almost forgotten till in the 16th century a German, of the name of Brunfels, roused this science from its lethargy.

§ 379.

SECOND EPOCH.

From BRUNFELS *to* CAESALPINUS;

From 1530 to 1583.

In the last epoch, little or nothing was done in botany during a space of some thousand years. With the catalogues of about 600 plants, a foundation was laid, but no prospect whatever of the structure to be erected upon this foundation.

This second period indeed presents us with more promising views. All science begins to revive, and monasteries are no longer the exclusive seat of human knowledge. Brunfelsius, Gesner, Fuchsius, Dodonaeus, the ever memorable Clusius, and the great Bauhin opened the path.

Otto Brunfelsius, son of a cooper, was born at Maynz, at the end of the 15th century. He was first a Carthusian friar, and became soon after cantor, (precentor), in Strasburg. After he had lived there about nine years, he applied with so much success to the practice of medicine, that he got an invitation to Bern, where he practised about a year and a half with general approbation, but on the 23d of November, 1534, he died there, lamented by the whole city. In his work* he has given the first figures of plants, and he was also the first botanist in Germany. The drawings are not very good, and do not in the least correspond with his own descriptions.

Hieronymus Bock was born at Heidesbach in Zweybruecken, 1498. He lived there for some years, but went afterwards to Hornbach, where he became clergyman and physician at the same time. He died in the 56th year of his age, the 21st of June, 1554. He changed his name, according to the fashion of his age, to the Greek name Tragus. In three books of his work* he treated pretty accurately of those

* Otto Brunfels Historia Plantarum, Argentorati, Tom. I. and II. 1530; Tom. III. 1536. New editions appeared in 1537 and 1539. The same work was translated into German, and published at Strasburg, 1532, in folio. The second part appeared 1537. We have, besides, an edition of it published at Frankfort, 1546, in fol.; and one in Strasburg, 1543, in 4to. The works of Brunfels are very scarce. He has written besides something on medicine, and on the plants of Dioscorides.

* Hieronymus Boak or Bock called Tragus, Kraeuterbuch von den vier Elementen, Thieren, Voegeln, and Fischen. Strasburg. 1549. fol. We have a Latin, new, altered German, and different new editions of the old one. This work begins to be scarce.

plants which grow in Germany, and represented the described plants in 567 figures, which are not bad. It is an objection made to him that he neglected the virtues of the plants, though he knew them perfectly well, and that he used the writings of the ancients too little.

Euricus Cordus was born in a small village in Hesse, and died 1538. He taught and practised medicine in Erfurt, Marburg, and Bremen. According to the general opinion, he was one of the most learned men of his age. He wrote several treatises on plants, especially those described by the ancients*.

His son Valerius Cordus was born 1515, and was unfortunately, when on his way to Rome, 1544, killed by a horse. His works† are rare, and the editions of Dioscorides which he published are still thought valuable.

Conrad Gesner, the greatest polyhistorian of his age, was born at Zurich, 1516, and died there 1565. He has written on several branches of natural history, botany, and physic. His works are as under ‡.

* Eurici Cordi Botanologicon, sive Colloquium de herbis. Coloniae. 1534. 8vo. His son published a second edition at Paris, 1551, in 12mo.

† Valerii Cordi Historia stirpium Argentorati. 1561. fol. The famous Conrad Gesner published this work after the author's death. The figures are taken from Tragus, and only 60 are new. The Zurich edition is quite the same.

‡ Conradi Gesneri Enchiridion historiae plantarum. Basil. 1541. 8vo. De plantis antehac ignotis. Without a year or place. 12mo. Historia plantarum. Basil. 1541. 12mo. De raris et admirandis herbis, quæ, sive quod noctu luceant, sive

Leonard Fuchsius was born in Bavaria, 1501. He studied at Heilbrun, Erfurt, and Ingolstadt, and after many changes of fate, came as professor to Tuebingen, where he died the 10th May, 1566. The emperor, Charles the Fifth, esteemed him very highly, and honoured him in various ways. He wrote a history of plants, of which many editions have appeared in German, French, and Latin †; he likewise wrote notes to Dioscorides, Galen, and Hippocrates, on which account he entered into a long dispute with the famous physician and philologist, John Heynbut or Hagenbut, who likewise called himself Cornarus. Cornarus published a treatise against him, entitled, Vulpecula excoriata. Fuchsius answered in another, with the title, Cornarus furiens; after which Cornarus finished the dispute with the publication of a work, which he termed Mitra, *s.* Brabyla pro vulpecula excoriata asservanda.

Peter Andreas Matthiolus, a physician at Siena, was born in the year 1500, and died at Trident, in 1577, of the plague. He was a very celebrated physician, and we owe him several new medicines. He had carefully studied the works of the ancients, especially of Dioscorides. His Kraeuterbuch, (work on

alias ob causas, Lunariae vocantur, Tiguri. 1555. 4to. This last is extremely scarce.

† Leonardi Fuchsii de historia stirpium commentarii insignes. Basiliae. 1542. fol. It has 512 figures, several of them taken from Brunfels, though larger. All the trees and smallest plants are drawn of the same size. There is another edition in 8vo. which is the first.

plants), was written originally in Italian, but we have French and German translations of it*.

Rembert Dodonaeus was born at Mechlen in 1517. He was one of the emperor's physicians, and well known for his skill all over Germany, France, and Italy. In the year 1583, he accepted of a call as Professor to Leyden, where he died 1585. His chief work † was far superior to any hitherto published, as well for the neatness and accuracy of the cuts it contained, as for the descriptions. It contains about 1330 very good figures, part of which are taken from Fuchsius, Clusius, and Matthiolus.

Matthias de Lobel, physician to King James I. of Great Britain, was born at Brussels in Flanders in 1538, and died in London 1616. Together with Peter Pena, a physician in Provence, he wrote the Adversaria, part of his greater work. He says that this physician sent him many rare plants. Some assure us, that he has in his works ‡ given many ideal figures of plants, and that he has described several

* Peter Andreas Matthiolus Kraeuterbuch, (work on herbs and plants), durch Joach. Camerarium. Frankfort. 1590. fol. with 1069 figures. The first Italian edition was without figures, and appeared at Venice in 1548.

† Remberti Dodonaei stirpium Historiae. Pemptades VI. Antwerp. 1616. fol.

‡ Matth. de Lobelii, (de l'Obel) Plantarum seu stirpium historia et adversaria. Antwerp. 1576. fol. Begins to be scarce. The number of the figures is 1495. Icones plantarum. Antwerp. 1581. Pars. I. et II. square 4to. The publisher of the first work, Christopher Plantin, has published this without prefixing Lobel's name. It has 1096 plates, with 2173 figures, mostly from Clusius and Dodonaeus.

as growing wild in Britain, which after him nobody could ever find.

The first is probably owing to the very bad manner in which his figures are drawn, which indeed never were faithfully copied. His Nymphaea lutea minor septentrionalium is an ill represented figure of the Nymphaea *minima* lately discovered in Germany. The second is to be attributed to carelessness, as he trusted too much to his memory, and hence often imagined he had seen a plant in Britain, which he, in fact, had met with in other countries.

Charles Clusius, or Charles de l'Ecluse, was born at Artois or Atrecht, in the Netherlands, 1526. His parents wished him to become a lawyer, and he went with this design to Loewen. But he soon changed his mind, and, from his great love to botany, soon undertook the most tedious and troublesome journeys through Spain, Portugal, France, Great Britain, the Netherlands, Germany, and Hungary. In his 24th year he already became dropsical, of which however he was cured by the use of succory, recommended to him by the famous physician Rondeletius. In his 39th year, in Spain he broke his right arm close above the elbow, falling with his horse, and soon after he had the same accident with his right thigh. In his 55th year, in Vienna he sprained his left foot, and eight years afterwards dislocated his hip. This last dislocation was neglected by his physician, and he had the misfortune to walk for the remainder of his life on crutches. The great pain and difficulty he had thus to suffer when walking, prevented him from taking the necessary exercise, in consequence of which he was affected with hernia, obstructions in his abdomen, and calculous complaints. Thus miserable and unhealthy, tired of the court of the emperor, where he had resided for fourteen years, and finding besides the superintendence over the gardens there too great a burden, he accepted in the year 1593 an invitation as Professor at Leyden, where he died April 6, 1609. Clusius was the greatest genius of his age, and prosecuted the study of botany with an enthusiastic zeal and a perseverance which was not equalled by any preceding philosophers, that of any of his followers. His works * exhibit the great botanist, and they will always remain valuable and indispensably necessary. The figures annexed to them are neat, the drawings correct, and his descriptions masterly. It was a pity that a man of so great merit, should have suffered so much, and even become the first martyr to botany.

§ 380.

THIRD EPOCH.

From CAESALPINUS *to* CASPAR BAUHIN.

Or from 1583 to 1593.

In this epoch Caesalpinus makes the first attempt to bring botany under a systematic form. Many

* Caroli Clusii rariorum plantarum historia. Tom. I. et II. Antwerp. 1601. fol. He wrote several small treatises, for

follow his example. The science becomes more universally attended to. Voyages to foreign parts of the globe are undertaken, and the great Bauhin reduces all these new discoveries to a certain order.

Andreas Caesalpinus came from Arezzo in Florence. He was called to Rome, where he died as physician to Clement the Eighth, the 25th of June, 1602. Before him plants had been described without the least order, and nobody thought, by attending to the similarity of different parts, to render the study of botany more easy. His system (§ 129) will render him ever memorable. The writings of this botanist * are so rare, that scarcely more than their titles are now known.

Jacob Dalechamp, born in the small place Caen in Normandy, in the year 1513, spent most part of his life at Lyons, and died there 1588, or according to some 1597. He was the first who intended to write a general history of all known plants, but by other occupations he was prevented from continuing it. An accomplished physician at Lyons, of the name of John Molinaeus, completed it at the desire of the bookseller Rovilli †.

instance, Plantae pannonicae, hispaniae, historia aromatum, which may be all found in the large work.

* Andr. Caesalpini de plantis libri XVI. Florent. 1583. 4to. Ejusd. Appendix ad libros de plantis et quaestiones peripateticas. Romae. 1603. 4to.

† Jacob Dalechampii Historia generalis plantarum, opus posthumum. Leyden, 1587. Vol. I. II. fol. 2686 cuts; these contain most of the figures of Cordus, Fuchsius, Clusius, Tragus, Matthiolus, Dodonaeus, and Lobel. More than 400

Joachim Camerarius was born at Nurenberg, the 6th of November, 1534, and died October 11, 1598. He lived with Melancthon at Wittenberg when a boy, and afterwards studied medicine at Leipzig. He then travelled over Italy, and graduated, 1551, at Rome. He was intimately acquainted with the greatest botanists of his age. By his great zeal for botany, he became noticed by Prince William, Landgrave of Hesse, who was very fond of gardening, and whose garden in Cassel he undertook to arrange. His nephew, Joachim Jungermann, a young but excellent botanist, went, by his desire, to the East, but had the misfortune, during his travels, to die of an infectious disease. Camerarius wrote several treatises on economical botany, and on the plants of the ancients. His principal work * contains 47 figures from Gesner's collection. For he purchased Gesner's whole collection of cuts, which amounted to about 2500. He made great use of them in his edition of Matthiolus, and in another work † still of great value.

are two or three times repeated, and the few original ones are exceedingly bad.

* Joachim Camerarii hortus medicus philosophicus. Francf. ad Moen. 1588. 4to. A small treatise of Joannes Thal, a physician in Nordhausen, the Sylvia Hercynia is added to it. This contains an accurate list of all the plants of the Harz. He died at Nordhausen, 1583, by a fall from his horse.

† Joach. Camerarii de plantis epitome P. Andr. Matthioli, Francf. ad Moen. 1586. 4to. with 1003 fig. Printed along with it is, Iter ad montem Baldum, Fr. Calceolarii. Franciscus Calceolarius, or as his proper name is, Calzolaris, was apothe-

Jacob Theodor Tabernaemontanus, a pupil of Tragus, took his name from his native place Bergzabern, a small village in Deuxpont. He was first an apothecary in Kronweissenburg, he went afterwards to France, returned as Doctor of Medicine, and at last died as physician to the Elector Palatine, at Heidelberg, 1590. He was generally esteemed for his great skill. His work* was not finished by himself. The second and third volumes were written by another, and are inferior to the first.

Since the Portuguese discovered a passage to the Indies round by Africa, many went thither for the sake of trade, as well as soon after the discovery of America by Columbus, love of money induced many to visit that country. Some of them, however, undertook these journeys for the investigation of natural history. Of these deserve to be named, Gar]

cary at Verona, and published this description of the plants of mount Baldo, in Italian, 1566; in Latin, 1571, at Venice before Camerarius.

* Jacob Theodor Tabernaemontanus Neuw vollkommen Kraeuter-buch, darinnen ueber 3000 Kraeuter mit shoenen kuenstlichen Figuren, &c. &c. Francf. a. M. 1588. Tom. I. fol. The second volume was published 1590 by Dr Nicolai Braun. There are several other editions by Caspar Bauhin, two published at Francfort 1613 and 1625, and two at Basil 1664 and 1687. The Latin edition is in square 4to; under the title, Icones plantarum sive stirpium tam inquilinarum quam exoticarum. Published twice at Francfort, 1588 and 1590. Many of the figures are taken from others, but they are all very distinct. The Latin editions are scarce.

sias ab Horto *, Christopher a Costa †, Joseph a Costa ‡, Nicolas Monardis, Gonsalvus Ferdinand Oviedo, Franciscus Lopez de Gomara, Franciscus Hernandez ||, and many others.

Leonard Rauwolff, a German, undertook a troublesome journey throughout the Levant. He travelled in the years 1573—1575, through Syria, Arabia, Mesopotamia, Babylon, Assyria, and Armenia. After his return he settled as physician at Augsburg On account of his religious profession, he was obliged to leave his native place, and died 1596, as physician to the emperor's army. He has published a very complete account of his journey ¶.

* Physician to the king of Portugal, he published something on Aromatics in 1563, in 4to. of which we have translations in all languages. Clusius got it printed along with his larger work.

† Surgeon, born of Portuguese parents in Africa, wrote likewise several treatises on Aromatics, to be found in Clusius.

‡ A Jesuit, wrote a work on animals, plants, and fossils. Barcelona. 1578. 4to.

|| Physician to King Philip the Second of Spain. Nova plantarum et mineralium Mexicanorum historia. Rom. 1651. Very rare but quite useless.

¶ Leonardi Rauwollf, bestallten Medici zu Augsburg, eigentliche Beschreibung der Rais, so er in die Morgenlaender vollbracht, in vier verschiedene Theile abgetheilt. Lauwingen, 1583. 4to. mit 43 Figuren von orientalischen Pflanzen. This edition has cuts, and is rarer than the oldest, which was published at Francfort, 1582. We have French and English translations of it. In the library at Leyden the herbarium which he collected in his travels, consisting of 350 plants, is still preserved.

Prosper Alpinus, from Marostica, near Venice, went on account of his love for botany to Egypt. After his return, he practised as physician in Venice, and then in Genoa; he came at last as Professor to Padua, where he died 1617. He was universally regarded as a very able man. Botany is indebted to him for the following writings*.

John Bauhin was born at Lyons, 1541. He was a pupil of Fuchsius, left his native country, and remained for some time in Yverdon, a town in the canton of Bern. He then went to Muempelgard, where he died as physician to the Duke of Wirtemberg, 1613. He travelled through the greatest part of Switzerland and Italy. When a youth, he commenced his great work †, which he only finished 52 years after.

Fabius Columna or Colonna, an Italian, was born 1567, and was president of the academy at Naples; he died 1648. He studied chiefly the older botanists. In his writings ‡ he has closely followed the an-

* Prosperi Alpini de plantis Aegypti liber. Venet. 1591. 4to. Another edition appeared there 1592. There are two other editions, one published at Padua 1630 and 1640, and another at Leyden 1735.

Ejusd. De plantis exoticis libri duo. Venet. 1655. 4to. Published by his son Alpinus Alpini.

† Johannis Bauhini Historia plantarum. Tom. I. II. III. Genevae. 1661. fol. with 3600 cuts. This work was published after his death, at the expence of Mr De Grafried, by Chabraeus.

‡ Fabii Columnae Φυτοβασάνος, sive plantarum aliquot historia, in qua describuntur diversi generis plantae veriores, ac magis facie viribus respondentes antiquorum, Theophrasti, Dio-

cients, without the least systematic arrangement. Of all works on botany his have the best plates. It is only pity that he represents all plants of the same size, whether they are large or small. He made the drawings for the plates himself.

§ 329.

FOURTH EPOCH.

From Caspar Bauhin *to* Tournefort.

Or from 1593 to 1694.

Through the persevering exertions of Caspar Bauhin, botany assumes a regular order. He becomes the guide of all other botanists. Discoveries still continue to be made, but fixed generic names, and the means of constituting genera, remain still unknown, till the immortal Tournefort founds a new system, and introduces new generic characters. Centuries elapsed before a system was formed; and

scoridis, Plinii aliorumque, delineationibus ab aliis hucusque non animadversae. Neapel. 1591. with 36 plates. There is a later edition at Florence, published 1744, with 38 plates, which is not by far so scarce as the former.

Ejusd. minus cognitarum nostro coeruleo orientium stirpium ἐκφράσις. Tom. I. II. Romae. 1606. 4to. Another edition appeared 1616, with 131 plates, which represent 247 plants. This book is very rare. The shop price is about 8*s.* but I know it has been sold for 4*l.* The new edition has better plates, and besides a treatise de Purpura, wanting in the first.

when it was formed, still another century passed away before it was thought necessary to fix genera, and to take the generic characters from the structure of the flower.

Caspar Bauhin, brother to John Bauhin, was born 1560. He travelled like his brother through Italy, where he discovered many plants, which John had overlooked. Bauhin got a Professorship at Basil, and died 1624. Several works * which he has left shew us that he was a great botanist. He succeeded well in his description of plants, and his figures are good. In the work which was to contain all known plants, many are wanting. His nomenclature was, before Tournefort, generally adopted.

Basilius Besler, an apothecary at Nurenberg, who died 1561, wrote, at the expence of the bishop of Aichstaedt, John Conrad de Gemmingen, a very elegant work†. Some however assert, that Besler

* C. Bauhini Φυτοπίναξ seu enumeratio plantarum ab herbariis descriptarum. Basil. 1598. 4to. witb 9 figures. The composition of this work took him 40 years; he has in it enumerated all the species, but considered many varieties as species.

Ejusd. Προδρόμος Theatri botanici. Basil 1560. 4to. An older edition of 1571 contains 140 cuts, which are very distinct.

Ejusd. Theatri botanici liber I. Basil. 1658. fol. with 254 fig.

† Basil. Besleri Hortus Eystettensis. Norimb. 1613. Royal fol. with 265 very neat plates, which represent 1080 plants.

only gave his name, and that the well known Ludwig Jungermann, Prof. at Giessen, was the real author.

Ludwig Jungermann was born Jun. 28, 1572, at Leipzig, died Jun. 26, 1653, at Giessen, as Professor of Physic. He was a very excellent botanist.*

Jacob Cornutius, a physician at Paris, described in a peculiar work, the plants which others had discovered in North America, and some growing in Europe in the gardens of Robinus†.

Johannes Loesel, Professor at Koenigsberg in Prussia, was born 1607, and died 1650. His Flora,‡ or an enumeration of all the plants which grow wild in Prussia, is the only work he has left us.

Joachim Jung was born at Luebeck, Oct. 22, 1587. He was for some time Professor at Helmstaedt; he afterwards went as rector to Hamburgh, and died September 22, 1657. In his writings‖ he

* Lud. Jungermann Catalogus plantarum quae circa Altorficum Noricum proveniunt. Published by Maurit. Hoffmann. 1615, 4to.

Ejusd. Catalogus plantarum horti et agri Altorfiani. Altorf. 1646. 12mo.

Ejusd. Cornucopiae florae Giessensis. Giessae. 1623. 4to.

† Jacob Cornuti plantarum canadensium aliarumque historia. Parisiis. 1635. 4to. Very rare, but now of little use.

‡ Johann Loeselii plantarum rariorum sponte nascentium in Borussia, catalogus Regiomonti. 1654. 4to. A later edition appeared at Franckfort, 1673. 4to.

Ejusd. Flora Prussica, edid. Joan. Gottsched. Med. Prof. Regiomonti. 1703. 4to. With beautiful plates.

‖ Joach. Jungii Doxoscopiae physicae minores, seu, Isagoge physica doxoscopica. Hamburgi. 1662. 4to. In the 2d and 3d part he writes on plants.

shews a great and extensive knowledge of nature. His remarks on the vegetable kingdom are just, and what he says on Terminology, and on the genera of plants, is done quite in the manner of Linné. Had his works been better known, and had he been situated more favourably for acting more at large, botany would perhaps have advanced in his time as far as it is now actually advanced.

John Wray, or as he calls himself after 1669, Ray, (Rajus), was born in the village of Black Notely, in Essex, November 29, 1628. During his travels through Great Britain, France, Germany, Sweden, and Italy, he paid great attention to all natural productions. He was a clergyman, and belonged to Trinity college, Cambridge; he resigned, however, his place before going abroad, and at his return lived as a private gentleman. Ray died a member of the Royal Society in London, January 17, 1705. He lived most part of his life in the country. The figure of the flower on which Tournefort founded his system, did not meet with his approbation, and a dispute on that account began between the two philosophers. He is the author of many works on botany, of which we shall only name a few*. He followed Jung in some parts, though

*Ejusd. Isagoge phytoscopica. Hamburgi. 1679. 4to. A new edition was published in Coburg, 1747, 4to. This last work was published after the author's death, by Joannes Vagetius. The works of Jung are very scarce.

* Catalogus plantarum, circa Cantabrigiam nascentium. Cambrigae. 1660. 8vo. This was the first work of Ray; it was published anonymously. Joan. Raji Historia plantarum ge-

not throughout. Ray was one of the most assiduous botanists, and likewise one of the most learned.

Johann. Sigismund Elsholz, born at Berlin, 1623, was physician to the elector Frederic William, and died June 19, 1688. He was the first author who wrote on the plants of the Marc Brandenburg†.

Paul Bocco, called afterwards Sylvius, was born at Palermo, 24th April, 1633, and died December 22, 1704. He was a Cistercian friar, and travelled a great deal through Italy. He has written several small treatises on single plants, but communicated the most remarkable and scarcest in the following works‡.

Robert Morison, a Scotsman, was born at Aberdeen, 1620, and died 1683, as Professor of Botany at Oxford, in consequence of a violent contusion of his breast by a waggon. As he had the superintendance of the botanical garden at Oxford, he had ample opportunity to examine the fruits of plants more carefully than any preceding botanists. He has been most esteemed for the accurate division of

neralis. Londin. Pars I. 1686. II. 1688. Tom. III. 1703. fol. The most important, and the last work he wrote.

† Joannis Sigismundi Elsholcii Flora marchica. Berol. 1663. 8vo.

‡ Pauli Bocco icones et descriptiones rariorum plantarum Siciliae, Melitae, Galliae, et Italiae. Edidit Morison. Oxoniae. 1647. 4to. With 52 plates, which represent 112 plants.

Ejusd. Museo di Fisica et d'Esperienze. Tom. I. Venet. 1607. 4to.

Ejusd. Museo de piante rare della Sicilia, Maltha, &c. Tom. II. 1647. 4to. These two constitute a work which is ex-the umbelliferous flowers, which is printed along with his larger work*.

Jacob Barrelier was born at Paris, 1634, studied medicine, and, just as he intended to graduate, became a Dominican friar. He travelled several times through Spain, France, Switzerland, and Italy. During his travels he chiefly paid attention to natural history. He made drawings of plants, insects, and shells, and intended to publish, like Columna, a botanical work, entitled, Hortus mundi, sive Orbis botanicus, which was to contain all known plants. While on a journey through Italy he became affected with asthma, which caused his death at Paris, Sept. 17, 1673. The plates have been published since his death†.

Franciscus van Sterrebeck was a clergyman at Antwerp, and died in 1684. Before him little attention had been paid to fungi. He took many from Clusius, added a great number of new ones, and

tremely rare, but at the same time is inferior in its plates to the first.

* Roberti Morisoni historia plantarum. Tom. II. III. Oxon. 1715. fol. with 292 plates, which represent 3600 plants. The first volume of Morison's work was never published. His small treatise on the Umbellatae has therefore been afterwards printed as the first volume, and passes under that title.

† Jacob Barrelieri Plantae per Hispaniam et Italiam observatae; opus posthumum accurante Antonio de Jussieu. Parisiis. 1714. fol. with 1327 plates, representing 1455 plants. The last plates contain many figures of zoophytes, and of 40 shells. Several of the figures are taken from Clusius and others.

wrote a particular work on them†. But his figures are very bad, as he has entirely neglected the true charateristic marks of fungi, and indeed seems to have given many fictitious representations.

Jacob. Breynius, merchant, and member of several societies, was born at Dantzig, 1637, and died of a deysentery, 1697. He corresponded with the first botanists of his age, and got from them many rare plants, which he described in several separate works‡.

Heinrich van Rheede tot Drakestein, born 1635, died December 15, 1691. He was governor of the Dutch settlements in the East Indies, and resided chiefly in Malabar. He procured drawings of the principal plants by the first artists, and described them and their use in the following works*.

Christian Menzel was born at Fuerstenwalde in the Marc Brandenburg, June 15, 1662. He is said

* Francisci Sterrebeck Theatrum fungorum, oft het Touneel der Campernoellen, *&c.* Antwerpiae. 1654. 4to. At the same place three other editions appeared of 1675, 1685, and 1712.

† Jacobi Breynii Exoticarum et minus cognitarum stirpium. Centuria I. Gedani. 1678. fol. Published at the author's expence. The 109 plates accompanying it are very neat.

Ejusd. Prodromus rariorum plantarum fasciculus I. II. Gedani, 1739. 4to. with 32 plates. This work was published by his son John Philip, a physician at Dantzig, who has likewise written several botanical treatises.

‡ Rheedi Hortus Malabaricus Indicus, cum notis et commentariis Joh. Commelini. Tom. I—XII. 1676, 1693. fol. with 794 very splendid plates. His descriptions are very accurate and faithful. Very scarce.

to have travelled a good deal on purpose to examine the different plants of his native country. He possessed likewise great skill in a variety of foreign languages, and was even well acquainted with the Chinese. Menzel was physician to his Majesty at Berlin, and died November 16, 1710*.

Johann Commelyn, a Dutchman, and Professor of Botany at Amsterdam, has written principally on the plants cultivated in the garden there. His most elegant work† was published after his death. Many notes of consequence were added by him to the Hortus Malabaricus.

Caspar Commelyn, a nephew of the former, and Professor at Amsterdam, was born 1667, and died December 25, 1731. He followed the footsteps of his uncle‡.

Rudolph Jacob Camerarius, Professor at Tuebingen, was born February 18, 1665, and died 11th September, 1721. Besides some dissertations and small treatises, inserted in the Acta Academiae Natur. Curiosorum, he did not publish any great

* Christ. Menzelii Index plantarum multilinguis, seu Pinax botanonimos polyglottos. Berolin. 1682. fol. with 11 plates, which represent 40 plants, not in a very superior style. Scarce.

† Joan. Commelini Horti medici Amstelodamensis rariorum tam orientalis quam occidentalis Indiae plantarum descriptio et icones. Opus posthumum a Fried. Ruyschio et Fried. Kiggelario. Amstelod. 1697. fol. The plates are beautiful, and the descriptions accurate.

‡ Casp. Commelini Flora Malabarica. Leyd. 1696. in fol. et 8vo. Ejusdem Praeludia botanica. Amsterdam. 1701 et 1702. 4to. Of the large work of his uncle, he published the second volume 1701. fol.

work on botany. Since Pliny, philosophers had spoken of the sexes of plants, but nothing certain had been said. Camerarius made the first experiments on this subject.

Paul Hermann, born at Halle in Saxony, July 30, 1640; was for a long time physician at Ceylon; he went afterwards to the Cape of Good Hope, and returned with a full collection of rare plants to Holland, where he became Professor at Leyden, and died January 25, 1695*.

Augustus Quirinus Rivinus, Professor of Botany at Leipzig, was born December 3, 1652, and died December 30, 1722.; one of the first botanists of that century. His system shews how excellent and acute an observer of nature he was†.

Leonhard Plukenet, physician at London, collected with unremitting zeal every thing remarkable in the vegetable kingdom, though he was not in very favourable circumstances. He made a collection of 8000 plants, which for his time was astonishingly large. At the end of his life the queen assisted him, and made him Professor and inspector of the royal gardens at Hampton Court. Plukenet was born 1642, and died 1706. No botanist at that

* Pauli Hermanni Horti academici Lugduno-Batavi catalogus. Leyd. 1687. 8vo.

Ej. Paradisus Batavus. Leyd. 1698. 4to. Published after his death by Sherard. A very useful work.

Ej. Museum Zeylanicum. Leyd. 1717. 8vo. and another edition in 1726.

† A. G. Rivini introductio generalis in rem herbariam. Lips. 1690. fol. A scarce work, with fine plates.

time collected or knew so many plants as he did. His collection is still kept in the British Museum. Though he was in possession of so great a number of plants, yet he was not systematic enough to make any considerable improvements on the science*.

Jacob Petiver, a rich grocer in London, who studied attentively natural history in general, and became member of the Royal Society, died 1718. He made few original discoveries. In his work† the plates are taken partly from his own collection, partly from the works of others.

Charles Plumier, a Franciscan friar, born at Marseilles, April 20, 1646; made three times a voyage to the West Indies, to describe the productions of the animal and vegetable kingdom. He died at last at the small island Gadis, near the sea port of Cadiz. Plumier made neat drawings of the plants he discovered during his travels, and gave most accurate descriptions. Of his numerous collection, he himself

* Leonhardi Plukenetii Phytographia. Lond. 1691 and 1692. 4to. with 328 plates.

Ejusd. Almagestum botanicum. Lond. 1696. 4to. Almagesti botan. mantissa. Lond. 1700. 4to. with 22 plates.

Ej. Amaltheum botanicum. Lond. 1705. 4to. with 184 plates. All those works are published under the general title, Opera omnia, and constitute a whole. The different plates together represent 3000 plants.

† Jacobi Petiveri opera omnia ad hist. naturalem spectantia. Vol. I. et II. fol. III. 8vo. Lond. 1704. This work comprehends all his writings. The plates represent animals, petrefactions, and plants promiscuously. The third volume is only text, and printed in 8vo.

and others after his death, have published but little †. The greatest part of his drawings and MSS. are preserved in the national library at Paris.

§ 382.

FIFTH EPOCH.

From Tournefort *to* Vaillant.

Or from 1694 *to* 1717.

Tournefort begins a new era in botany. He fixes the genera more accurately from the structure of the flower, and arranges all known plants. Philosophers begin to arrange gramina and foreign plants according to Tournefort's method, which becomes known all over Europe, till Vaillant shews that all the genera are not yet rightly fixed, and approaches nearer to truth than any preceding naturalist.

Joseph Pitton, called from his native place, Tournefort, was born at Aix in Provence, June 5, 1656;

† Charles Plumier description des plantes de l'Amerique, avec leurs figures. Paris 1693. fol. with 108 plates. Very scarce.

Caroli Plumieri nova plantarum Americanarum genera. Parisiis. 1703. 4to.

Ejusd. Filices, ou Traitè des Fougeres de l'Amerique, en Latin et en Francois. Paris. 1705. with 172 plates, which represent 242 plants. This scarce work contains the figures of all the Filices of America, and is on this subject still the best.

he travelled through France, the Pyrenees, over England, Holland, Spain and Portugal, and went at the king's expence to the Levant. He became afterwards Professor of Botany, and a knight. Unfortunately he lost his life 28th November 1708, from a contusion on his breast, by a carriage. By his system, and his better discrimination of the genera, he acquired great fame, which could only be obscured by the superior merits of Linné. During his travels in the Levant he was accompanied by a gentleman called Gundelsheimer, who afterwards founded the botanical garden at Berlin. Tournefort's collection of plants is kept in the library at Paris, and that of Gundelsheimer in the library of the Academy of Sciences at Berlin *.

Sir Hans Sloane, an Irishman, born 1660, studied medicine in France, went to Jamaica, became afterwards physician at London, and President of the Royal Society. He died January 11, 1753. His numerous collection of natural curiosities is deposited in the British Museum. He was a great patron of science in general †.

* J. Pitton Tournefort relation d'un voyage de Levant. Paris. 1717. 4to. Vol. I. II. We have a German translation, published at Nuernberg, 1776. in 3 vols. 8vo. This work contains many plates.

Ejusd. Institutiones rei herbariae. Tom. I. II. III. Paris 1719. 4to. with 489 plates. This is the third edition, by the care of Jussieu. I never saw the older ones.

† Hans Sloane, Esq.; a voyage to Madeira, Barbadoes, Nevis, St Christophers, Jamaica, with the Natural History. London. 1707. fol. A very scarce work, which is even in London sold for 10l.

William Sherard, a great amateur of natural history, who spared no expence with regard to botany. He was a long time British consul at Smyrna, and founded, after his return, at his country seat at Eltham near Oxford, a very fine botanical garden. Except some treatises in the Philosophical Transactions, he wrote nothing on botany. Sherard intended to continue the Pinax of C. Bauhin, but died when occupied with it in 1738. He has left a certain sum which is given as a salary to a Professor of Botany in Oxford, who is to publish his great collection of drawings.

Olaus Rudbeck, born at Upsal, March 15, 1660; took his degree at Utrecht in 1690, succeeded his father, and died March 23, 1740. His father was the famous Swedish polyhistorian, Olaus Rudbeck, Professor of Botany at Upsala. He intended to describe a number of scarce plants in twelve volumes, with elegant cuts. His work was entitled, Campi Elysei. But by the great fire, which in 1702 laid almost all Upsal in ashes, his herbarium and this work were lost. Two copies of the first, and six of the second volume, are still existing, and considered as great curiosities*. The father did not survive this great loss, but died December 12, 1702. The

* I saw a copy of this extremely scarce work in the library of Mr Leysser at Halle. The present possessor of the Linnean herbarium, has published a new edition of it, under the following title: Reliquiae Rudbeckianae, sive camporum elyscorum libri primi, qui supersunt, adjectis nominibus Linnaeanis. Lond. 1789. fol.

son has, some dissertations excepted, written nothing on botany.

Johan. Jacob Scheuchzer, Professor of Mathematics at Zurich, was born 2d August 1672, and died 1738. He travelled repeatedly through the Alps*, and became on this account very celebrated.

Johann. Scheuchzer, physician at Zurich, has acquired immortal fame in botany, by describing and discriminating the gramina more accurately than had before that time been done. His only fault is, that his descriptions are too prolix †.

Maria Sybilla Merian, daughter of the famous Dutch engraver, Math. Merian, born in 1647. Her great love for Entomology induced her to go for some time to Surinam, to observe with her own eyes the metamorphoses of the many insects there. After her return, she published a most splendid work ‡ on the metamorphosis of insects, in which several plants likewise were drawn, which Caspar Commelyn described. Some copies are most splendidly coloured by herself. Miss Merian died 1717.

* J. Jacob Scheuchzeri novem itinera per alpinas regiones facta. Tom. I. IV. Leidae. 1723. 4to. Amongst numerous plates it contains 38 figures of plants.

† Joh. Scheuchzeri Agrostographiae prodromus, Tiguri. 1708. fol.

Ejusd. Agrostographia sive graminum, juncorum, cyperorum, cyperoidum iisque adfinium historiam Tiguri. 1719. 4to. The first small work is printed along with this.

‡ Maria Sybilla Merian Metamorphosis insectorum Surinamensium. Ant. 1705. 1709. fol. with 60 plates, and Dutch and French text.

Hermann Boerhaave was born near Leyden, in the village Voorhout in 1668. His father, a clergyman, wished him to take orders, and he was therefore obliged to study divinity. When on a little journey, he met with a merchant, against whom he defended Spinoza's doctrines. That gentleman, in consequence of this, informed against him as a heretic, and follower of Spinoza, and hence he abandoned his former study entirely. Boerhaave afterwards became Professor of Medicine, Chemistry, and Botany, and died September 30, 1738. His fame as physician and natural philosopher, is known all over Europe*.

Engelbert Kaempfer, born in the county of Lippe in 1651. None of the older botanists ever travelled so extensively as he did. For he journeyed ten years in Russia, near the Caspian Sea, in Persia, Arabia, Hindostan, Coromandel, at the banks of the Ganges, in Java, Sumatra, Siam, and Japan, where he remained two years. During these travels he discovered and communicated to the world† many new plants, especially of Japan. His work consists of five numbers, the last of which contains descriptions and figures of Japanese plants. The sixth number, which contained 600 figures of scarce plants, grow-

* Herm. Boerhaave Index alter plantarum horti academici Lugduno-Batavini. Pars I. II. Lugd. 1727. 4to. with 39 plates, which represent mostly plants of the Cape.

† Engelb. Kaempferi fasciculi quinque amoenitatum exoticarum. Lemgo. 1712. 4to. with many plates, which, however, are not very neat.

ing at the Ganges, has been entirely lost. He died November 12, 1719.

Louis Fouillée, a Franciscan friar, travelled to Peru and Chili. He published his very accurate journal, containing his observations, and paid particular attention to the officinal plants *.

§ 383.

SIXTH EPOCH.

From Vaillant *to* Linne.

Or from 1717 *to* 1735.

Vaillant's perspicacity discovers the faults in Tournefort's system, and in his genera. He fixes new genera, endeavours to bring the smallest plants, as mosses and fungi, under a certain classification, and first clearly points out the sexes of plants. What Vaillant was unable to do, to arrange the mosses accurately and justly, has been ably executed by Dillenius and Micheli. Linné's great genius gives the whole science a more favourable appearance, and botany now becomes, what it should have been long before, a structure resting upon a firm foundation.

* Louis Feuillée Journal des observations physiques, mathematiques et botaniques, faites par ordre du Roi, sur les cotés orientales de l'Amerique meridionale. Paris. Tom. I. II. 1714. Tom. III. IV. 1725. 4to. We have an extract of the botanical part in German.

Sebastian Vaillant was born 26th May, 1669, at Vigny in France. He studied surgery, but his great love for botany induced him to study this science exclusively. Tournefort, whose pupil he was, did every thing in his power to complete the education of his very promising pupil. He became demonstrator of botany at Paris. From too great a zeal for botanical knowledge, he travelled on foot through all the neighbourhood of Paris, and thus became consumptive, which put (May 21, 1722), an end to his active life.

The smaller plants became the chief object of his attention. He recognised in the pollen of the Parietaria the semen masculinum, and did not, with Tournefort, consider it merely as an excrementitious matter of the flower *.

Heinrich Bernhard Ruppius, a student at Giessen, was born to be a botanist. He travelled through the greatest part of Germany on foot, content with poor sparing diet, often sleeping in the open air. His knowledge of plants was far more than superficial, and he often even distinguishes plants by their stamens, and enumerates many new genera †.

* Sebastiani Vaillant botanicon Parisiense, ou dénombrement par ordre alphabetique des plantes, qui se trouvent dans les environs de Paris. Leidae. 1727. fol. with very neat plates, published by Boerhaave, after the author's death. Several smaller treatises are to be found in the Memoires de l'Academie de Paris.

† Henrici Benhardi Ruppii Flora Jenensis. Francf. and Lips. 1788. 8vo. Haller published a new edition at Jena, in 1745.

Johann. Jacob Dillenius, born in Hesse, 1684; became professor in his native city, but was soon called to Oxford, as professor, where he died in 1747. Like Vaillant he could instantly discriminate the smallest plants. Dillenius has characterized the mosses, and his descriptions stand as a model of perspicuity. He could himself draw and engrave*.

Johann. Christian Buxbaum was born at Merseburg, in Saxony, in 1694, and studied at Leipzig, Jena and Wittenberg. The great Friedrich Hoffmann in Halle, recommended him to Count Alexander Romanzof, who went as ambassador to Constantinople. He visited many parts of Greece, and returned to Petersburg. This he left in a bad state of health, and died July 17, 1730, at Wermsdorf, near Meresburg†.

* Joh. Jacob Dillenii Catalogus plantarum sponte circa Giessam nascentium. Giessae. 1719. 8vo.

Ejusdem Hortus Elthamensis. Londin. 1732. fol. with 324 good plates, which represent 417 plants. This has again been published without text, under the title, Horti Elthamensis icones et nomina. Leyden. 1774. fol. with Linnaean names.

Ej. Historia Muscorum. Oxon. 1741. 4to. with 85 plates, which represent about 600 mosses; an incomparable work. In this department of botany nothing almost had been done, and in his work it has been first fully treated of. It is very scarce, for there were scarcely 250 copies printed. A separate reprint of the plates appeared in London. 1763.

† J. C. Buxbaumi Plantarum minus cognitarum Cent. V. Petropol. 1728. 4to. The last Centuries were published by Gmelin, the sixth never appeared. He gives many figures of African plants which he found in the East.

Peter Antony Micheli, a poor gardener, was born 1679; he was in his last years inspector of the botanical garden at Florence, and died January 1, 1736. None of his predecessors dissected flowers so minutely. He first observed the true flower of mosses, though he did not distinguish accurately the different parts of it. Micheli was likewise the first who discovered the fruit of fungi*.

§ 384.

SEVENTH EPOCH.

From Linne' *till* Hedwig, *or from* 1735 *to* 1782.

Linné demonstrates the presence of sexes in plants, shows the only right way to constitute genera, invents a new system, and arranges accordingly all known plants. His pupils are dispersed all over the globe, and discover new plants. His system becomes known throughout all Europe, and every where finds adherents. Hedwig at last discovers the flowers of mosses.

Carolus von Linné was born in the Swedish village Rooshoolt, in the province Smaland, May 23, 1707. His father, a clergyman, wanted him to study divinity; the gay youth, however, preferred the open air, and the gathering of plants. This made his father destine him for a shoemaker. Thus, had not the

* P. A. Michelii nova plantarum genera. Florent. 1729. 4to. with 108 very neat plates. It is a pity that the second part of this excellent work has been lost.

provincial physician at Wexioe, Rothmann, interested himself for him, and persuaded his father to let him study medicine, Linné's great genius would have been for ever suppressed. Linné spent his academical life under a great many hardships, and in great poverty. Celsus, professor of divinity at Upsal, and Rudbeck, at last began to favour him. He travelled at the expense of the academy through Lapland, got, after his return, acquainted with the daughter of Dr Moraeus, afterwards his wife, who presented him with money to go to Holland to take his degree. Boerhaave recommended him to Dr Cliffort, of whose garden and herbarium he had full use, and who sent him for a short time to England. After Rudbeck's death he became professor of botany at Upsal. The king made him baronet, and at last archiater, and knight of the order of the Polar Star. He died January 8, 1778. Linné's works are too numerous for us to mention them all, it will suffice to notice the last and best editions of his principal works *. His real merit in botany consists in having constituted the genera on better principles, given proper generic and trivial names, introduced a better terminology, described the species more accurately,

* Carl a Linné. Systema plantarum curante D. Joh. Jac. Reichard. Francf. a M. Tom. I. II. III. IV. 1779 and 1780. 8vo.

Ejusd. Genera plantarum curante J. Christ. Dan. Schreber. Francof. a M. Tom. I. 1789. II. 1790. 8vo.

Ejusd. Species plantarum, curante D. Carl Ludwig Willdenow. Tom. I. II. III. Leipz. 1801. 8vo.

and invented a new comprehensive system founded upon the sexes of plants.

Albrecht von Haller was born 1708. He studied at Leyden under the direction of the great Boerhaave, became professor of anatomy and botany at Goettingen, left that celebrated academy, and went to Bern, where he became president of the great senate, and died 1777. Haller was one of the greatest geniuses of our present age, great as anatomist, physiologist, botanist, physician, poet, politician, and † man of letters.

John Gottlieb Gleditsch, was born June 5, 1714, at Leipzig. He studied there, and travelled through several parts of Saxony. From Berlin, where he resided for some time to attend the anatomical lectures, he went to the estate of Baron von Ziethen of Trebnitz, where he founded a botanical garden. When Frederick the Great re-established the Academy of Sciences, he was called to Berlin. There he was honoured with the title of Aulic Counsellor, and died after a very active life, October 5, 1786. His restless activity, soft, mild temper, and constant good humour, made him, even when a very old man, the favourite of that city. Of his writings I shall only mention those which have made him particularly known *.

† Albrechti ab Haller historia stirpium indigenarum Helvetiae. Bernae. 1768. Tom. I. II. III. fol. with 48 plates.

* Joh. Gottl. Gleditschii Methodus fungorum. Berol. 1753. 8vo.

Ejusd. Systema plantarum a staminum situ. Berol. 1764. 8vo.

Johann. Burmann, professor of botany at Amsterdam, in possession of the scarcest collections of African and Asiatic plants, has made many of these treasures public*. He never followed, however, the Linnaean method.

Johann. Friederich Gronovius, doctor and chief magistrate at Leyden, and a great friend of Linné, published the plants collected by Rauwolf and Clayton, and described them according to Linné's method. Died in 1783 †.

George Eberhard Rumphius was born at Hanau. He went as physician to the East Indies, where he became chief magistrate and president of the mercantile association of Amboyna, and collected carefully all the productions of India, especially plants; but was, in old age, unfortunate enough to lose his sight entirely, so as to judge of every thing by the touch only. Died 1706 ‡.

Johann Gottlieb Gmelin was born in 1710, at Tuebingen; went at the advice of some friends in 1727 to Petersburg, where he became a member of the academy there. He travelled through Siberia,

* Joh. Burmanni Thesaurus Zeylanicus. Amstel. 1737. 4to. with 110 plates, which represent 155 plants.

Ejusd. rariorum Africanarum plantarum Decas I. IX. Amstel. 1738, 1739. 4to. with 180 plates, containing 215 figures of the scarcest plants.

† Joh. Fried. Gronovii Flora Virginica. Pars. I. et II. Lugdun. 1743. 8vo.

Ejusd. Flora orientalis. Lugdun. 1755. 8vo.

‡ Georgii Everhardi Rumphii Herbarium Amboinense. Tom. I—VI. cum auctuario. Amstel. 1750—1755. fol. with 196 plates.

and died 1755. From the MSS. left by the unfortunate Steller, Gmelin published a work, the two last volumes of which appeared after his death *.

John Hill, an Englishman, had an idea of getting all the plants mentioned by Linné engraved. This very large work however is useless, on account of the very bad figures, and indeed of too enormous a price. Most of the drawings are not taken from nature but from descriptions. It is not therefore surprising that they often do not bear the slightest resemblance to the natural plants †.

Charles Allione, Professor of Botany at Turin; an old botanist, still alive, has paid great attention to the plants of his native country ‡.

George Christian Oeder was called to Copenhagen in 1752, where he became Professor of Botany. In 1770 the institution to which he belonged as Professor became disannulled. He became afterwards bailiff at Trondheim, and finally went as provincial judge to Oldenburgh, where he remained till the end of his life, which happened January 28, 1791. A few years before, he was ennobled. Besides many other botanical treatises, he has particular

* Joh. Gottl. Gmelin Flora Sibirica. Tom. I—IV. Petropol. 1748, 1769. 4to. with 299 plates. The two last volumes were published by his nephew Sam. Gottl. Gmelin; the fifth, however, which contains Cryptogamiae, is not yet printed.

† John Hill's Vegetable System. Vol I.—XXXVI. London, 1759—1775. fol. with 1521 plates, which represent 5624 plants, but no trees, gramina, or cryptogamic plants.

‡. Caroli Allione Flora Pedemontana. Tom. I. II. III. August. Taurin. 1785. fol. with 92 plates.

merit in publishing the Flora Danica, which the King of Denmark still patronizes *.

Nicolaus Laurentius Burmann, who lately died, Professor of Botany at Amsterdam, was son of John Burmann. He used the great collection, which his father had left, entirely for the benefit of the science, and published part of it, according to the arrangement of Linné his great master †.

John Anton Scopoli, was born at Fleimsthall in the Tyrol, 1722. Almost without any instruction he became, by his own diligence, a very great man, and an acute observer of nature. He was first physician at Idria, went afterwards to Schemnitz in Hungary as Professor, and lastly to Pavia, where he died, May 3, 1788. By too frequent a use of the microscope, a year before his death he lost his sight. It is singular that a man whose whole life was a series as it were, of misfortunes, should have done so much.

* Flora Danica, Hafn. fol. Oeder began this splendidly coloured work in 1766. He published three volumes before the year 1770. A volume consists of three numbers, each containing 60 plates. After his death it was continued by the famous zoologist Otto Frederic Mueller, who died in 1787. The continuation was afterwards intrusted to Professor Vahl, and at present 20 numbers are published; consequently 1200 plates, with the figures of Danish plants.

† N. L. Burmanni Flora Indica. Lugd. 1768. 4to. with 67 plates, which represent 176 very scarce plants.

‡ Joh. Ant. Scopoli Flora Carniolica. Tom. I. II. Vindb. 1772. 8vo. with 65 plates.

Ejusd. Deliciae Florae et Faunae Insubricae. Tom. I. II. et III. Ticini 1786. fol. with 75 plates. An elegant work, of which only a few copies were printed.

Johann Christian Daniel von Schreber, born 1739, a pupil of Linné, President of the Imperial academy, and Professor at Erlangen. One of the first botanists, whose great merits are universally acknowledged. His writings bear the marks of mature reflection and just observation *.

Nicolaus Joseph von Jacquin was born in the Netherlands. He made a voyage, at the expence of the Emperor Francis I. to the West Indies, became afterwards Professor at Schemnitz, whence he went in the same quality to Vienna. This botanist, who is still living, has done much for the progress of the science, and we have in fact from him most of the new discoveries in botany. His works are unfortunately too expensive ‡.

Jacob Christian Schaeffer, a clergyman at Ratis-

* J. C. D. Schreberi Spicilegium Florae Lipsiensis. Lipsiae 1771. 8vo.

Ejusd. Beschreibung der Graeser (Description of the Gramina). Vol. I. and II. Edit. 1st.—3d. Leipzig, 1769—80. fol. with 40 coloured plates. It is a pity that the learned author has not continued this work.

‡ N. Jos. Jacquini Flora Austriaca. Vol. I.—V. Vindobon. 1773—78. fol. with 500 coloured plates. Very scarce.

Ejusd. Miscellanea Austriaca. Vol. I. II. Vindob. 1778—81. 4to. with 44 coloured plates.

Ejusd. Collectanea ad Botanicam, Chemiam et Historiam Naturalem. Vol. I.—V. Vindob. 1786—96. 4to. with 106 coloured plates.

Ejusd. Icones plantarum rariorum. Vol. I. III. Vindob. 1781—93. fol. with 648 coloured plates.

Ejusd. Plantarum rariorum horti Cesaræi Schoenbrunnensis descriptiones et icones. Vol. I. II. Vindobon. 1797. fol. with 250 coloured plates.

bon, should not be passed unmentioned, as he was the first who published coloured prints of fungi. For German botanists his work is classical, particularly with respect to the larger species *.

Charles Linné, the son, was born at Upsal, January 20, 1741. In his nineteenth year he became demonstrator of botany, got, after his father died, the botanical professorship, and died November 1, 1783. He had much botanical knowledge, but did not equal his father †.

Peter Jonas Bergius, Professor of Natural History at Stockholm, celebrated for his investigations of the plants of the Cape and of Surinam ‡.

Samuel Gottleib Gmelin, Professor of Botany at Petersburg, a nephew of the former, born in 1753. He has given very accurate descriptions of sea plants ||.

Samuel George Gmelin, travelled through several parts of Russia for the purposes of natural history. He died in prison at the Cham of the Chaitakkes, 1774, shortly before he was to have been ransomed*.

* Dr Jac. Christian Schaeffer fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur icones, nativis coloribus expressae. Vol. I.—IV. Ratisb. 1762. 4to. with 330 coloured plates. The fourth volume contains the systematic description of them all.

† Carl a Linné Supplementum plantarum. Brunsw. 1781. 8vo.

‡ P. Jon. Bergii Plantæ Capenses. Holm. 1767. 8vo. with five plates.

|| Sam. Gottl. Gmelin Historia Fucorum. Petrop. 1768. 4to. with 33 copper-plates.

* Samuel George Gmelin Reisen durch Russland, (Travels through Russia), Vol. I.—III. Petersburg, 1770—1789. 4to. with 18 plates.

Peter Simon Pallas, born at Berlin, went to Petersburg, and travelled at the expence of her Imperial Majesty Catherine II. through the Asiatic provinces of Russia. The result of these travels this great philosopher has communicated to the world, likewise at the expence of the Empress. It is to be wished that the author may continue this elegant work †.

Johann Gerard Koenig from Curland, was an apothecary, and afterwards studied under Linné. He went afterwards to Copenhagen, from whence he visited Iceland in 1765. After his return, he accompanied the mission, as physician, to Tranquebar in the East Indies in 1768. During this voyage, he collected at the Cape of Good Hope many unknown plants, and sent them to his instructor Linné. His zeal for botany had no bounds, but his pecuniary circumstances were not in his favour. He entered as natural historian the service of the Nabob of Arcot, from whom he got a better salary, which he spent entirely in his various investigations. But still, though in better circumstances, finding that his income would not suffice for the execution of his extensive plans, he petitioned the Directory of Madras for an additional salary, which was granted. He died June 26, 1785, without having all his discoveries published. Single treatises of his are inserted in different periodical publications; and in the third number of Retzii Observationes Botanicae, we have his masterly descriptions of all the Monandriae of the East Indies; and in the sixth number, an enumera-

† P. S. Pallasii Flora Rossica. Tom. I. Pars. 1. 2. Petro. fol. 1784. 1788. fol. with 100 coloured plates. The text has been separately printed in 8vo.

tion and description of all the Indian species of Epidendron.

Christian Friis Rottböll, who died in 1797, Professor of Botany at Copenhagen, has described a great many foreign plants. His chief merit is the description of several exotic species of gramina*.

Fusée Aublet, a Frenchman, was an apothecary, and went with a great deal of botanical knowledge to Guyana in America. After having made there a great many discoveries in botany, he went to the Isle of France or Mauritius, and returned to France, where he died some years ago†.

It is to be regretted that Aublet is not to be depended on with regard to the generic characters. Later Botanists who have travelled over the same places, have found that his delineations of the parts of the flower are very erroneous, and it appears as if he had intentionally designed them so.

Johann Reinhold Forster, late Professor at Halle, and his son George Forster, private counsellor and librarian at Maynz, made a voyage round the world with Captain Cook. Both philosophers have communicated to the world an account of the plants which they discovered during their voyage ‡.

* Christiani Friis Rottböllii Descriptiones et icones Plantarum. Hafniae, 1773. fol. with 21 plates. An improved edition appeared in 1786.

† Fusée Aublet Histoire des Plantes de la Gujane Françoise. Tom. I.—IV. Lond. et Paris, 1775. 4to. with 392 plates.

‡ Joh. Reinh. Forsteri Characteres Generum Plantarum, quas in itinere ad insulas maris australis collegit. Lond. 1776. 4to. with 75 plates.

Conrad Moench, Professor at Marburg, has favoured us with many excellent botanical observations *.

Bulliard died in 1796 as demonstrator of botany at Paris. He wrote several treatises on the plants which grow wild in the neighbourhood of Paris; and, in his larger work, described the rarest fungi †.

Chevalier Lamarck, Professor of Helminthology, and member of the national institute at Paris, has shewn himself, by the publication of a great botanical work ‡, a very expert botanist.

Andreas Johann Retzius, still living, and Professor of Botany at Lund in Sweden, was born October 3, 1742. We are indebted to him for several new discovered plants by travellers, and for many important observations ||.

Georg. Forsteri Plantæ esculentæ insularum oceani australis. Halæ, 1786. 8vo.

Ejusd. Florulæ insularum australium prodromus. Goettingae. 1786. 8vo.

* C. Moench Enumeratio Plantarum indigenarum Hessiæ præsertim inferioris. Pars Prior. Casselis. 1777. 8vo. The second part has never been published.

Ejusd. Verzeichniss auslaendischer Bäume und Straeucher des Lustschlosses Weissenstein bey Cassel. (Catalogue of foreign trees and shrubs in the palace of Weissenstein near Cassel.) Frankf. and Leipz. 1785. 8vo. with eight uncoloured plates.

Ejusd. Methodus Plantas horti Botanici et agri Marburgensis a staminum situ describendi. Marburgi. 1794. 8vo.

† Bulliard, Herbier de la France, with many coloured plates.

‡ Chevalier de Lamarck Encyclopedie methodique. Tom. I. II. III. Paris, 1783, 1784. 4to. with numerous plates.

|| And. Joh. Retzii Observationes Botanicae. Fasc. I.—VI. Lips. 1779—1791. fol. with 19 plates.

Charles Peter Thunberg, knight of the order of Vasa, and Professor at Upsal, is the son of a country curate. He visited Holland and France, and went, assisted by some friends in Holland, to the Cape of Good Hope, Ceylon, Java, and Japan. Thunberg has written a great deal on several botanical subjects, and we have still more to expect from him. His Flora Japonica is a model which deserves general imitation *.

Sir Joseph Banks, Bart. and President of the Royal Society in London, in company with his friend Dr Solander, made the first voyage with Captain Cook round the world. Sir Joseph is in possession of the largest herbarium, and of the scarcest natural productions in general. We expect from him an elegant work on all the plants of the southern part of India. This great man is the patron of natural history in general †.

We must content ourselves with mentioning the names only of some other celebrated botanists who

* C. P. Thunberg Flora Japonica. Lipsiæ, 1784. 8vo. with 39 plates.

Ejusd. Icones Plantarum Japonicarum. Upsaliæ, 1794. fol, only 10 plates have appeared uncoloured.

Ejusd. Prodromus Plantarum Capensium pars prior. Upsaliæ, 1794. 8vo. with three plates. This first part contains the short characters of all the plants which he discovered at the Cape of Good Hope, up to the tenth class of Linné.—The complete Flora Capensis is to be published soon, which will be a gratification to many who wait for it with anxiety.

† Josephi Banks Reliquiae Houstonianae. Londini, 1781. 4to. with 26 plates.

would deserve a more particular account, were our limits not so narrow. They are, Miller, Ludwig, Ammann, Van Royen, Seguier, Sauvages, Gessner, Steller, Gerber, Georgi, Guettard, Messerschmidt, Kalm, Hasselquist, Osbeck, Loeffling, Vandelli, Forskoel, Adanson, Schmiedel, Hudson, Lightfoot, Gouan, Necker, Weigel, Murray, Commerson, Sparrmann, Wulffen, Leers, Cranz, Medicus, Pollich, Weber, Asso, and many others.

§ 385.

EIGHTH EPOCH.

From HEDWIG *till our present time.*

Or from 1782 to 1805.

Though Linné arranged all the productions of nature, and in the vegetable kingdom observed decidedly the sexes of plants, yet he had not succeeded in discovering the sex and the sexual organs in the cryptogamiæ. Hedwig alone was so fortunate. To him we are indebted for a better knowledge of the cryptogamiæ, and an entire reform in this important branch of botany. Many men of merit undertake tedious and dangerous journeys through the most distant regions of our globe, and by them we expect

Ejusd. Icones selectæ Plantarum, quas in Japonia collegit et delineavit Engelbertus Kaempfer ex Archetypis in Museo Britannico asservatis. Lond, 1791. fol. Contains 59 uncoloured plates, left by Kaempfer, with systematic descriptions.

to get acquainted with scarce and unknown natural productions. This whole century may, with regard to natural history, justly be called the century of discovery. It must however be admitted, that, did philosophers really wish to make their writings more generally useful, they would make their works less expensive, and not give us repeatedly copied plates, which only renders the study less attainable. Besides, we are so unfortunate since Linné's death to get new plants under different names, and to see new names given to plants already known. Should this anarchy become prevalent in botany, we must expect to see again the old times, where each author gave to his plant the name he fancied to be the best.

Johann Hedwig, Professor of Botany at Leipzig, born at Cronstaedt in Transylvania, Oct. 8, 1730, studied medicine at Presburg in Hungary, and died Feb. 7, 1779, at the age of 69 years. He discovered, by means of an extremely high magnifying microscope, that those parts in mosses, which Linné took for female flowers, were male flowers, and that those which were thought to be the male flowers were seed capsules only. His discoveries relate likewise to the filices, algae, and fungi*.

* Johannis Hedwigii Fundamentum Historiae Naturalis muscorum frondosorum. Pars I. II. Lipsiæ, 1732, with 20 plates.

Ejusd. Theoria generationis et fructificationis plantarum cryptogamicarum. Petropol. 1784. 4to. with 37 coloured plates. In 1798, a new, corrected, and much enlarged edition of this work was published.

Ejusd. Descriptio et Adumbratio muscorum frondosorum.

Jonas Dryander, a Swede by birth, who lives with Sir Joseph Banks; a very profound botanist, who by some single treatises, has gained much reputation. The description of Sir Joseph Banks's library, which he has published shews his great knowledge*.

Charles Louis l'Heritier de Brutelle, formerly member of the National Institute at Paris, has made himself known by the descriptions of several new plants. He has especially described many Peruvian plants, discovered by Dombey during his travels. His works are rather of too large a size, and on account of the many elegant plates very expensive†.

George Franz. Hoffmann, born in Bavaria, was Professor at Erlangen, but went 1792 to Goettingen, as Professor of Botany. He has, by descriptions

Tom.—IV. Lips. 1787—1797, with 160 neatly coloured plates. Not continued.

A posthumous work on mosses, containing their general history, has been since published by Dr Hedwig's favourite pupil, Dr F. Schwaegrichen of Leipzig. It is Hedwig's Species Muscorum, with his own drawings; and his son and successor in the botanical chair has published some others. T.

* Catalogus Bibliothecae Historico-Naturalis Josephi Banks, auctore Jona Dryander. Tom. III. 1797—98. The third volume contains the botanical works, which the author has arranged in a particular order. But what renders this work indispensibly necessary for every botanist is this, that all the known and new plants which botanists have described in periodical works, or in the publications of academies and learned societies, are enumerated here, according to Linné's system.

† C. L. l'Heritier, Cornus. Parisiis. 1788. fol. with plates. Ejusd. Sertum Anglicum. Paris. 1788. fol. with many plates. Not yet finished.

and drawings, pretty well explained some extensive genera, not yet properly fixed *.

Anton. Joseph Cavanilles, born at Valencia; an abbé who lived with the Spanish ambassador at Paris, but now resides at Madrid, and has several times travelled through Spain. He has deserved well of botanists, by having described and accurately discriminated the Monadelphiae. He intends now, in a particular work, to describe the plants in the botanical garden at Madrid, and some new plants of Spain†.

Ejusd Stirpes novae. Fasc. I.—VI. 1784—1789. with 84 neat uncoloured plates. Continued.

Ejusd. Geraniologia seu Erodii, Pelargonii, Geranii, Monsoniae et Grieli historia, iconibus illustrata. Parisiis. 1787. fol. Only 44 plates without text have hitherto appeared. He has promised an accurate description of the genus Solanum, and to publish Dombey's Flora Peruviana.

* Georgii Francisci Hoffmanni Enumeratio Lichenum. Fasc. I—IV. Erlangae. 1784. 4to. with many plates. It is a pity it is not continued.

Ejusd. Historia Salicum. Tom. I. Lips. 1785. fol. with 24 plates. This work is not finished, though it is much to be wished that the author may continue it.

Ejusd. Plantae Lichenosae. Tom. I—III. Lipsiae. 1790—1796. fol. Each volume has 24 elegantly coloured plates, and it is to be continued. This work is very useful to the botanist, only the generic names are not very accurate.

† Ant. Joseph Cavanilles Monadelphiae Classis Dissertationes decem. Matriti. 1790. 4to. with 296 elegant plases.

Ejusd. Icones plantarum. Vol. I—III. Matriti. 1791—1794. fol. Each volume contains 100 uncoloured plates, neatly engraved; with the 4th volume the whole will be concluded. It contains a great treasure of New Mexican and Spanish plants.

Johann. Jacob Roemer, and Paulus Usteri, two physicians at Zurich, have published journals of botany, in which many discoveries are collected, and by which botany has gained many admirers and friends. In the beginning they published this journal both together *, afterwards each a separate one.

Joseph Gaertner, physician at Kalve, near Stuttgard, died in 1791. His particular merits consist in an accurate inquiry into the nature of seeds. His work is most useful, as it fills up a large empty space in the physiology of these organs †.

Olof Swartz, now professor at Stockholm, resided from 1783 till 1787 in the West Indies, where, though Browne, Sloane, Plumier, Aublet, Jacquin, and some others had before him visited these countries, he still discovered many plants entirely unknown. He has made these discoveries known, and and thus has contributed to the better knowledge of

* Magazinder Botanik, herausgegeben von J. J. Roemer und P. Usteri. I.—IV. Band Zuerch. 1787—1790. 8vo. (Botanical Magazine, published by J. J. Roemer and P. Usteri).

Dr Usteri afterwards published Annalen der Botanik (Annals of Botany), 1—2. Vol. Zuerch. 1792, 1793, 8vo.

Neue Annalen der Botanik (New Annals), No. 1—16. Zuerch. 1794—1797, 8vo. This last journal is still continued, and contains many interesting articles.

Dr Roemer has begun a new journal, remarkable for its elegance, and the good choice of communications, viz.

Archiv für die Botanik, 1—3 Stück (Magazine for Botany, No. 1—3), Leipzig. 1796—1798. 4to.

† Josephi Gaertueri de fructibus et seminibus plantarum, vol. I. II. Stuttgard, 1788—1791. 4to, with 180 neat plates.

plants. The Cryptogamiae especially, have gained much by his discoveries *.

James Edward Smith, physician at Norwich, and president of the London Linnaean Society, was fortunate enough to purchase the whole Linnaean herbarium. It could not have come into better hands, for from it he has characterized more accurately several scarce and but imperfectly known plants, and by publishing descriptions of many new plants, especially of New Holland, and fixing the genera in the filices on more solid foundations, he has gained everlasting fame. His writings are of great value to the botanist †.

* Olof Swartz nova genera et species plantarum seu Prodromus descriptionum vegetabilium maximam partem incognitorum, quae sub itinere in Indiam occidentalem digessit. Holmiae, 1788. 8vo.

Ejusd. Observationes botanicae, Erlangae. 1791, with 11 plates.

It appears but just to observe, that Mr Swartz saw the greatest part of the plants described in his prodromus first in Sir Joseph Banks's collection. They were, at least 12 years before Mr Swartz wrote this work, collected and sent to Sir Joseph by Dr Wright, now in Edinburgh. T.

Ejusd. Icones plantarum incognitarum quas, in India occidentali detexit atque delineavit. Fasc. I. Erlang. 1794. Only six neatly coloured plates have been published.

Ejusd. Flora Indiae occidentalis aucta atque illustrata, sive descriptiones plantarum in prodromo recensitarum. Tom. I. II. Erlangae. 1797, 1798. Continued. The first volume contains 15 neat plates representing the anatomy of the new genera.

† Jacobi Edward Smith Plantarum icones hactenus ineditae. Londin. Fasc. I. II. III. 1789—1791. fol. with 75 good plates.

William Aiton, inspector of the Royal Botanic Garden at Kew near London; died 1794. An excellent observer, who has presented us with an elegant description of the plants in the garden at Kew*.

Johann. de Loureiro, a Portugueze, went as missionary to Cochinchina, but as he could not, without medicine, succeed in his plans, he studied the productions of the vegetable kingdom. After a residence there of about 30 years, he went with a Portugueze ship to Mozambique, and finally returned to Portugal. We have from him a valuable work on the plants which he met with during his journey†.

Jacob Julian la Billardiere, physician at Paris, intended, after he had travelled through the mountains of Dauphiny and Savoy, to undertake a botanical journey, under the patronage of the minister de Vergennes, through Asia Minor as far as the Caspian

Ejusd. Icones pictae plantarum rariorum. Fasc. I—III. Lond. 1790, 1791, 1793. An expensive work. Each fascicle has 6 well-coloured plates.

Ejusd. Specimen of the Botany of New Holland, vol. I. Fasc. I. IV. Lond. 1793. 4to. 1794. Each fascicle contains four neatly coloured plates.

Ejusd. Flora Britannica. Vol. I. II. III. 8vo.

* Hortus Kewensis, or a catalogue of the plants cultivated in the Royal Botanic Garden at Kew, by William Aiton, Vol. I. II. III. Lond. 1789. 8vo. with a few very good plates. A new edition of this useful work is expected.

† Joannis de Loureiro Flora Cochinchinensis. Tom. I. & II. Ullissipone. 1790. I have myself published an edition of it in 8vo. in 1798, by Spener, with notes.

Sea. He left Marseilles, November 19, 1786, and arrived in Syria, February 1787. The plague, however, which then raged in those countries which he intended to visit, obliged him to alter his plan, and confine himself to Syria only. Fifty or sixty new-discovered plants he has begun in a masterly manner to describe in a particular work *.

Martin Vahl, professor at Copenhagen, has travelled through the greatest part of Europe, and North Africa. The Arabic plants of Forskoel, as well as those of the West Indies, which his friends Rohr, Ryan, and West collected, many East Indian plants, and a great many discovered by himself, are communicated to us in his writings †. Vahl has shown himself one of the greatest botanists of the age.

Frederic Stephan, professor and counsellor at Moscow, born at Leipzig, has published a Flora of Moscow, and he has promised an elegant work on new Asiatic plants ‡.

* J. J. Billardiere, M. D. Icones plantarum rariorum Syriae descriptionibus et observationibus illustratae. Parisiis. Decas I. 1791, Decas II. 1791. 4to. The plates and descriptions are excellent. It is a pity that no more has been published.

† Martini Vahl Symbolae plantarum. Pars I.—III. Hafniae, 1790—1794. fol. Each volume has 25 plates; all three, therefore, 75.

Ejusd. Eclogae botanicae. Fascicul. I. Hafn. 1796. fol. with 10 plates.

‡ F. Stephan enumeratio stirpium agri Mosquensis. Mosquae. 1792. 8vo.

Ejusd. Icones plantarum Mosquensium. Decas I. Mosquae. 1795. fol.

Frederick Alexander von Humboldt, chief counsellor of mines in Prussia, born at Berlin, has much contributed to the knowledge of subterraneous plants *. Physiology, especially the physiology of plants, owes to him a great many important discoveries and explanations. His unwearied zeal for science makes us hope for a great many excellent communications in consequence of his extensive travels.

Christian Conrad Sprengel, once rector at Spandau, now a private gentleman at Berlin, discovered, after many tedious examinations and observations, the true manner in which nature has provided for the fecundation of plants. He has written a particular work on the subject, full of important observations †.

Heinrich Adolph. Schrader, Doctor of Medicine at Goettingen, has besides dry cryptogamic plants, of which he published collections, written several works, which contain many very excellent observations ‡.

* Florae Fribergensis specimen, edidit Fried. Alex. ab Humbaldt. Berolini. 1793. 4to. with four neat, uncoloured plates, representing 19 subterraneous plants.

† Das entdeckte Geheimniss der Natur in Bau und in der Befruchtung der Blumen, von C. C. Sprengel. (The secrets of nature in the structure and fecundation of flowers, by C. C. Sprengel), Berlin. 1793. 4to. with 14 plates, which contain a great number of neat figures crowded together.

‡ Spicilegium Florae Germanicae Auctore H. A. Schrader. Hannov. 1794. in 8vo. with 4 plates, which represent various cryptogamic plants, and the seeds of some species of Galium.

William Roxburgh, an Englishman by birth, now physician at Samulcottah on the coast of Coromandel, has, by the advice of Dr Russel at Madras, and at the expence of the East India Company, under Sir Joseph Banks's direction, begun to publish an elegant but very expensive work on the useful plants of India *.

Johann Christoph Wendland, born at Landau, and overseer of the gardens at Herrnhausen, near Hanover, has made many important and interesting experiments and discoveries on the great number of plants which are cultivated there. Those he has communicated to the world in several treatises, especially in his greater works †.

Ejusd. Nova genera plantarum, pars prima. Lipsiae. 1797. fol. with 6 elegantly illuminated plates. It contains some species of fungi.

* Plants of the coast of Coromandel, selected from drawings and descriptions presented to the Hon. Court of Directors of the East India Company, by William Roxburgh, M. D. Vol. I. London. 1795. in large folio. Only three numbers have appeared, each with 25 beautiful plates, drawn very faithfully after nature. Many new Indian plants are delineated, very well dissected and described in English.

† Sertum Hanoveranum, seu plantae rariores quae in hortis Hanoverae vicinis coluntur, descriptae ab H. A. Schrader, delineatae et sculptae a J. C. Wendland. Goettingae. 1795, fol. maj. Mr Wendland published this work in the beginning with Mr Schrader, and three numbers of it have appeared. The fourth is published by Mr Wendland alone. The drawings and plates are done by this gentleman himself, in the first numbers the descriptions and the original observations are likewise his work, and the last number is entirely his own.

C. H. Persoon, born at the Cape of Good Hope, now residing at Goettingen, has paid particular attention to the study of fungi, and is one of our first mycologists. Several of his treatises which contribute much to the elucidation of his subject, are inserted in Usteri's annals. One particularly important is separately printed *. He has promised a larger work on the fungi.

Francis Masson, a gardener and zealous botanist. The king of Great Britain sent him in 1772 to the Cape of Good Hope to collect plants for the botanic garden at Kew. He remained there two years and a half. After his return he made several botanical journeys to the warmer climates at the expence of the Emperor of Germany, and of the Kings of France and Spain. He was sent a second time at the expence of England in 1786, to the Cape of Good Hope, where he remained ten years, and during this long time he made more discoveries than

This work is now finished, but it will be continued by Mr Wendland alone, under the title, Hortus Herrenhusanus. It contains twenty-four plates, prettily coloured, of new and little known plants.

Botanische Beobachtungen nebst einigen neuen Gattungen and Arten von J. C. Wendland. (Botanical observations, with a few new genera and species), Hanover 1798. fol. with four coloured plates, which contain very distinct representations of thirty-three dissected plants.

Ejusd. Ericarum icones et descriptiones. Fasc. I. Hanoverae. 1798. 4to. This fascicle contains drawings of six species of heath, very prettily coloured, with a description in German, and their characters in Latin.

* Observations mycologicae, seu descriptiones tam novorum

the first time, and more than any person before him had done. He has published his discoveries * of several new species of Stapelia.

Samuel Elias Bridel was born November 28, 1763, at Crassier, a small village in the Canton of Bern. He went to Paris, and travelled through the mountains of Switzerland to collect plants, especially mosses. Mr Bridel resides at present at Gotha in Saxony. We are indebted to him for a complete history of the musci frondosi, which he still continues †.

Eugenius Johann Christoph Esper, Professor at Erlangen, was born at Wundsiedel, June 25, 1742. His merit is very great in Zoology and Entomology, as appears by his writings on the Papiliones of Europe, and on Zoophyta. He has commenced a com-

quam notabilium fungorum, exhibitae a C. H. Persoon. Pars prima. Lipsiae. 1796. 8vo. with six coloured plates.

* Stapeliae novae, or a collection of several new species of that genus discovered in the interior parts of Africa, by Francis Masson. Lond. 1795, fol. with forty-one neatly coloured plates. Each plate contains a new species. During his travels in the interior of Africa he took up those succulent plants out of the soil with their root, and cultivated them in his garden at Cape Town, and thus had an opportunity of seeing many flowers which escape travellers who make hasty journeys over a country.

† Muscologia recentiorum s. Analysis, historia, et descriptio methodica omnium muscorum frondosorum hucusque cognitorum ; ad normam Hedwigii, a S.E. Bridel. Gothae. Tom. I. 1797. II. Pars I. 1798. 4. The first volume contains the history of the musci frondosi, the description of the order, of the genera, and their varieties. The first part of the second

plete work on sea-plants or Fuci *, and is, in this epoch, the first German who has written on this difficult genus. However Esper only collects the known species, and does not examine, what is still unknown, their organs of generation.

Henry Andrews, a distinguished painter in London, has delineated, in very elegant plates, a number of rare plants, and all the Cape heaths, which have been introduced into the English gardens †.

Erich Acharius, a provincial physician at Wadena in Sweden, has enriched the science with a work which is indispensible for the accurate knowledge of the genus Lichen. He has made a new arrangement of them, and described 529 species so well that one has no difficulty in determining them ‡. In the vo-

volume describes the species of the first genera. Of six uncoloured plates four represent the genera of the musci, and two some new species.

* Icones fucorum, s. Abildungen der Tange, published by E. J. C. Esper. Nuernberg. 1797. 4to. Two fascicles have only appeared with sixty-three coloured plates, containing the description of the represented species. It would have been better, had some of the figures been drawn with more accuracy and in a less coarse manner.

† The Botanist's Repository for new and rare plants in English and Latin, by Henry Andrews, Vol. I. II. London 1797, 1800, 4to. Each volume contains 72 elegantly coloured plates, with a leaf of description.

Engravings of Heaths, with botanical descriptions in Latin and English, No. 1—23, London, folio. The number contains three coloured plates, and to each is added half a sheet of description ; but neither the plate nor the description are numbered.

‡ Lichenographiae Suecicae Prodromus ; Auctore Erik Acharius, Lincopiae, 1798, 8vo. with two beautifully coloured plates.

lumes of the Academy of Sciences he has also described some lichens.

Renatus Desfontaines, professor of botany at Paris, undertook in 1783 a journey into Barbary. He remained there above two years, and travelled over the kingdoms of Tunis and Algiers, as also a part of Mount Atlas. In a particular work * he has communicated his discoveries. It is very rich in the grasses, the umbelliferae, the ringentes, the tetradynamious, papilionaceous and compound flowers, but poorer in the class Cryptogamia.

E. P. Ventenat, Librarian of the Pantheon, and Member of the National Institute at Paris, has published a description of the new and rare plants cultivated in the rich and spacious garden of M. Cels †.

Graf Franz von Waldstein, knight of Malta at Vienna, and Paul Kitaibel, professor at Pesth, have for several years travelled over various provinces of Hungary, and have discovered upwards of three hundred new plants, which they have described in a particular work ‡.

* Flora Atlantica, sive Historia plantarum quae in Atlante, agro Tunetano et Algerensi crescunt. Auctore Renato Desfontaines. Tom. I. II. Paris 1798, 4to, with 261 elegantly engraved uncoloured plates, exhibiting most of the new plants discovered by him.

† Description des plantes nouvelles et peu connues cultivées dans le Jardin de J. M. Cels, avec figures, par E. P. Ventenat, 1—3, livraison. Paris 1799—1801, large 4to. Each number contains ten admirably engraved uncoloured plates.

‡ Plantae rariores Hungariae iconibus illustratae; Auctoribus F. de Waldstein et Kitaibel. Vol. I. Viennae 1802.

Hippolytus Ruiz and Joseph Pavon, professors at Madrid, travelled together from the year 1777 to the year 1788, through Peru and Chili, to investigate the plants and animals of those distant regions. The number of new plants they discovered exceeds all expectation, so that botany has never at one time received such an accession as through the labours of these distinguished travellers. It would have been still greater, had they not, by various accidents, lost a great part of their collection *.

Andreas Michaux, a French naturalist, member of the National Institute at Paris, was employed for twenty years in travelling through the East, and over North America, and afterwards went with Captain Baudin, a voyage round the world. By him we have a description of the oaks of North America †, which

fol. with 100 elegantly coloured plates, and accurate descriptions of the species.

* Florae Peruvianae et Chilensis Prodromus; sive novorum Generum plantarum Peruvianarum et Chilensium descriptiones et icones: Auctoribus H. Ruiz et Pavon: Madrid 1794, folio, with thirty-seven uncoloured plates, which contain the delineation of the flowers and fruits of one hundred and forty-nine new genera. The descriptions are in Latin and Spanish.

Eorundem Flora Peruviana et Chilensis, sive descriptiones et icones plantarum Peruvianarum et Chilensium. Madrid, tom. I, 1798. tom. II. 1799. folio. The second volume reaches only to the class Pentandria and the order Monogynia. To the first volume belong one hundred and six, and to the second, one hundred and sixteen very excellent uncoloured plates, which represent the new species, and upon each plate two plants are delineated.

† Histoire de Chenes de l'Amerique par André Michaux,

appeared during his voyage, without the Flora of that country, which he had left finished.

As the bounds of an Elementary work do not permit me to give here a complete history of Botany, I must content myself with indicating by name alone, those moderns to whom the Science is most indebted: viz. Afzelius, Baumgarten, Bellardi, Bernhardi, Bolton, Bompland, Bonato, Boos, Bosc, Bredemeyer, Brotero, Cels, Cervantes, Curtis, Cyrillo, Dahl, Danau, Desrousseaux, Dickson, Dombey, Ehrhart, Euphrasen, Fahlberg, Floerke, Flügge, Fraser, Froelich, Funck, Gawler, Geuns, Goodenough, Haenke, Hayne, Hellenius, Hoffmannsegg, Holmskiold, Hoppe, Hornstädt, Host, Hull, Isert, Jussieu, Klein, La Peyrouse, Lee, Liljebad, Linck, Lumnitzer, Maertens, Martyn, Marschall von Bieberstein, Menzier, Mikan, Mühlenberg, Mutis, Nee, Nocca, Olivier, Panzer, Patterson, Poiret, Richard, Rohr, Roth, Rottler, Rudolphi, Ryan, Salisbury, Schmidt, Schousboë, Schrank, Schumacher, Sims, Starche, Sowerby, Stokes, Tafalla, Thouin, Thornton, Timm, Ucria, Vellozo, Villars, Wahlenburg, Walter, West, Wiborg, Willemet, Withering, Woodward, Zuccagni, &c. &c.

Paris, 1801, folio, with thirty-six excellent uncoloured plates. The oaks are very scientifically delineated, and the descriptions good; it were to be wished, however, that more precision had been given to the character of the species.

EXPLANATION OF THE PLATES.

PLATE I.

FIG. 1. The leaf of the Pelargonium *peltatum* is peltated p. 68. and pentangular, p. 55.

2. The leaf of the Orange, Citrus *Aurantium*, is ovate, p. 53. quite entire, p. 56. and has a winged footstalk, p. 37.

3. Lichen *stellaris* is an Alga, p. 154. with a stellated frons, p. 73. and scutellæ, p. 151. in the middle.

4. Agaricus *conspurcatus* is a Fungus, p. 154. the stipes is annulated, p. 82. the annulus is sessile, p. 82. the pileus umbonated, p. 83. and squarrose, p. 83.

5. A granulated root, p. 18. of the Saxifraga *granulata.*

6. Peziza, a small fungus, p. 154. with a naked stipes, p. 34. and a concave pileus, p. 83.

7. Geastrum *pedicellatum*, a fungus with a stellated volva, p. 82. of a spherical figure, p. 85. and ciliated orifice.

8. The leaf of the Spiræa *Filipendula*, is interruptedly pinnate, p. 62; the pinnula, p. 71. is lanceolate, and unequally dentated.

G. 9. The scapus of the Equisetum *arvense*. This plant belongs to the Filices spiciferæ, p. 155.

10. The flower of the Equisetum much magnified, shewing four antheræ, and a style without a stigma.

11. The spike of the Equisetum consists of numerous peltated hexangular receptacles, raised on a footstalk. One of these receptacles is here much magnified, to which the horn-shaped indusia, p. 86. are attached, containing the flower exhibited in the former figure.

12. The root of the Spiræa *Filipendula,* which is tuberous and pendulous, p. 19.

13. The root of the Ophrys *corallorhiza* is dentated, p. 16.

14. Celastrus *buxifolius* has a flexuose stem, p. 28; thorns, p. 91.; obovate leaves, p. 70. which stand in bundles, p. 67.

15. The polypodium *vulgare* is a Filix which bears its flower and seed on the back of the frons, filix epiphyllosperma, p. 155; the root is horizontal, p. 17.; the frons is circinated and pinnatifid.

16. A palmated root, p. 18. of the Orchis *latifolia*.

17. A tunicated bulb, p. 19. of Allium *Cepa*.

18. A testiculated root, p. 18. of Orchis *mascula*.

19. The scaly bulb, p. 19. of Lilium *bulbiferum*.

20. Sida *hederaefolia* has a sarmentose stem, p. 28. heart-shaped leaves, p. 52. which are repand, p. 57. petiolated, p. 68. and pallaceous, *ibid.* The flowerstalk is radical, p. 38. the perianth is simple, p. 98. the corolla is mallow-like, p. 106. the filaments are connate, p. 115.

21. The bundled root, p. 18. of Ophrys Nidus avis.

PLATE II.

FIG. 22. A rhombic leaf, p. 54. of Hibiscus *rhombifolius.*

23. Malva *tridactylites* has a trifid leaf, p. 52. a one flowered peduncle, p. 37. a double perianth, p. 96. a malvaceous corolla, p. 106. and belongs to the 16th class of Linnæus, viz. Monadelphia, p. 171.

24. A panduræform leaf, p. 54. of Euphorbia *cyathophora.*

25. Banisteria *purpurea* has a twining stem turning from the right to the left, p. 29. opposite leaves, p. 66. which are elliptic, p. 53. and bear a corymbus, p. 47.

26. Part of a straw, p. 32. with a leaf, and at the base a strap, p. 80.

27. The Passiflora *tiliæflora* has a round stem, p. 30. a heart-shaped leaf, p. 52. double stipulæ, p. 75. an axillary tendril, p. 88. a one-flowered peduncle, p. 37. a polypetalous corolla, p 104. nectaria which consist of straight threads, p. 110. and a pedicelled germen, p. 119.

28. Nepenthes destillatoria has a lanceolate leaf, p. 54. which bears a pedicelled ascidium, p. 79.

29. A four-cornered stem, p. 31. with stellate leaves, p. 67. which stand six together, *ibid* and are linear, p. 59.

30. A vetch with leaves alternately pinnate, p. 62. the pinnulæ, p. 71. are mucronated, p. 51. the flowers stand in a racemus, p. 45. the corolla is papilionaceous, p. 107.

31. An ovate leaf, p. 53. which is emarginated, p. 52.

FIG. 32. The Humulus *lupulus* has a stem which twines from the left to the right, p. 29. opposite leaves, p. 66. tri-lobed, p. 55. and toothed, p. 57.

PLATE III.

33. The spike, p. 43. of the Orchis *latifolia*, having floral leaves, p. 77.; the germen is below, p. 120.; the corolla is orchideous, p. 107.

34. The panicle, p. 47. of the Poa *trivialis*.

35. The leaf of the Lacis *fluviatilis*, which is laciniate, p. 55. and curled, p. 58.

36. A compound Umbel, p. 46. with an universal involucrum, p. 81.; and a partial one.

37. The Catkin, p. 49. of the Hazel, covered with scales, p. 102.

38. Bupleurum *rotundifolium*, with a perfoliate stem and leaf, p. 29.; it has a depauperate umbel, p. 47. and a pentaphyllous involucrum, p. 80.

39. The Scolopendrium *vulgare*, with a dedaleous leaf, p. 52. belongs to the Filices epiphyllospermæ, p. 155.

40. The filiform receptacle, p. 148. of the Hazel.

41. The flower of the Arum *maculatum*, with an univalve spatha, p. 78. in the centre of which stands the spadix, p. 48.

42. The Spadix of the foregoing flower, with female flowers below, and male flowers above.

43. The Cyme, p. 47. of the Viburnum *Opulus*, having large neuter flowers, p. 96. at the extremities.

44. Sagittaria, *sagittifolia* has arrow-shaped leaves,

FIG. 44. p. 53. a channelled leaf-stalk, p. 37. and a three-sided stalk *(scapus)*, p. 33. The flowers stand in whirls, p. 40. and are tripetalous, p. 107.

PLATE IV.

45. A stamen of the Digitalis *purpurea*, the filament, p. 115. is incurved, p. 116. the anther doubled, p. 116.

46. The pistil of the Turnera *frutescens*. The germen is oblong and trisulcated, with three styles which are multifid, p. 120.

47. A stamen of the same, the filament of which is dilated, p. 115. and its anther cordated.

48. A stamen with a compressed cordate filament, p. 115. and erect anther, p. 118.

49. The flower of the Antirrhinum *Orontium*, has a personate corolla, p. 106. with a spur at the bottom, p. 112.

50. The whole flower of the Teucrium *fructicans* has an unilabiate corolla, p. 106. the filaments are filiform, p. 115. turning up *(adscendentia)*, the style filiform, p. 120. and the stigma bifid, p. 122. The flower belongs to the class Didynamia.

51. The Corolla of the foregoing flower is monopetalous, p. 104. and has only the under-lip, p. 109.

52. The flower of the Philadelphus *coronarius*, with a four petalled corolla, p. 107.

53. The monophyllous quadrifid perianth, p 98. of the foregoing flower. As the stamina are nu-

merous, and inserted in the calyx, the plant belongs to the class Icosandria.

54. The pistil of the same flower.

55. A stamen with a compressed filament and incumbent anther, p. 118. which is moveable, *ibid.*

56. A malvaceous corolla, p. 106. with connate filaments, p. 115.

57. The double perianth, p. 98. of the same flower, in the centre of which is seen the united filaments.

58. The stamina of the Carolinea *princeps*, the filaments of which are connected below, but above stand free; in this figure the most of the filaments are cut away, leaving one to shew that it is branched, p. 115. The anthera is round and upright.

59. The flower of the Centaurea *Cyanus* is compound, p. 95. and enclosed in a common perianthium, p. 100. which is imbricated and turbinated, p. 102.

60. A floret taken from the disc of the foregoing flower; it is tubular, p. 104. and the germen is crowned with a pappus, p. 103.

61. A floret from the radius of the same flower, which is difform, p. 105.

62. The flower of the Campanula *rotundifolia*, with a five-parted perianth, p. 99. and a bell-shaped corolla, p. 104.

63. The stamen of a Vaccinium has a filiform filament and an awned anther, p. 117.

64. The stamen of the Yew-tree, with a peltated and dentated anther, p. 117.

65. The stamen of a Lamium, with an incumbent anther, which is hairy, p. 117.

66. The Galanthus *nivalis* has a one-flowered spatha,

p. 78. a liliaceous, three-petalled corolla, p. 107. a triphyllous crown, p. 113. and a germen inferum, p. 120.

67. A stamen with an awl-shaped filament, p. 115. and an erect, p. 118. arrow-shaped, p. 117. anther.

68. A stamen of the Glechoma *hederacea*, with a kidney-shaped anther, p. 116. which is lateral, p. 118.

69. A stamen with an adnate anther, p. 118.

70. The pistil of the Iris *germanica* has an oblong sulcated germen, a filiform style, p. 120. with three stigmata, which are petal-like, p. 122.

71. The flower of the same, with a germen inferum, p. 120. a one-petalled, liliaceous six-parted corolla; three of the segments are erect, and three are bent back; on these last there is a beard, p. 113.

72. The flower of the Salvia *officinalis*, with a ringent corolla, p. 105.

73. The bilabiated perianthium of the same. p. 99.

74. The pistil of the same has four seeds, a filiform style, and divided stigma.

75. The Bellis *perennis* has a compound flower, p. 95. it is a flos radiatus, p. 96. the centre is called the *disc*, and the rim the *ray*.

76. The same flower seen from behind, to show the common hemispherical anthodium, p. 102.

77. A conical common receptacle, p. 149.

78. The flower of the Galium *boreale* seen sideways.

79. The wheel-shaped corolla of the same, p. 105. belonging to the class Tetrandria, p. 171.

80. A stamen of the Salvia *officinalis*, with a moveable articulated filament, p. 115.

81. The flower of the Symphytum *officinale* slit up, to show the fornices, p. 112. under which the

FIG. 81. stamina stand, and show the plant to belong to the class Pentandria.

82. The same flower has a cup-shaped corolla, p. 104.

FIG. 83. The flower of the Periploca *graeca*, with its pentapetalous corolla, p. 107. and horn-like threads, p. 113.

84. A ligulated corolla, p. 105. of the Hieracium *sylvaticum*; the antherae are connate, p. 118. which is the character of the class Syngenesia.

85. The compound flower of the same, consisting wholly of ligulate florets. It is called a semifloscular flower, p. 96. and belongs to the order of Polygamia aequalis.

86. A tubular floret, p. 104. of the Carduus *nutans*.

87. The same opened longitudinally, to show the character of the 19th class.

88. The flower of the Periploca *graeca*, without the corolla and horn-shaped filaments. It is merely the hood (cucullus, p. 111.) with the stamina that are shown.

89. The pistil of the same much magnified, the germen double, the style simple, and the stigma very large.

90. A stamen of the same plant highly magnified, with the beard, p. 113.

91. A petal of the same bending outwards, with two horn-shaped filaments.

92. The same with figure 90. only the anthers burst.

93. A many-flowered spicula, p. 42. of a grass, the Festuca *elatior*.

94. The three stamina, with the pistil and nectarium of the same grass. The nectarium, p. 110. surrounds the seed; the stigmata are plumose, p. 122. the filaments capillary, p. 115. and the antherae bifid, p. 117.

FIG. 95. The corolla of the same grass, with the pistil and stamina; the corolla is bivalve, p. 100.

96. The bivalve glume, with the seed.

97. The same glume apart, by which we may see that the valves, p. 126. are of unequal length.

98. The flower of the Stapelia *hirsuta*, diminished about a fifth part.

99. The two germens of the same flower.

100. The polyphyllous crown, p. 113. of the same.

101. A many-flowered spicula of the Bromus *secalinus*.

102. The bivalve glume of the same.

103. The bivalve corolla, with an awn, p. 93.

104. The bivalve glume, with the zigzag rachis.

105. The papilionaceous corolla, p. 107. of a Vicia.

106. The vexillum of the same, p. 107.

107. The alæ of the same, *ib*.

108. The carina of the same, *ib*.

109. The stamina of the same, showing the character of the class Diadelphia, p. 171.

PLATE V.

110. The flower of the Lychnis *Viscaria* has a tubular perianthium, p. 99. a pink-like corolla, p. 106. and belongs to the class Decandria.

111. The petal, p. 108. of this plant has a long unguis, p. 108. and a bidentated crown, p. 113.

112. The flower of the Cucullaria *excelsa* much magnified. It has an irregular corolla, p. 107. a spur, p. 112; the antheræ, p. 116. are attached to the undermost petal, and the stigma, p. 121. is club-shaped.

113. The same flower of its natural size.

114. The funnel-shaped corolla, p. 105. with a beard, p. 109. of the Lasiostoma *cirrhosa*.

FIG. 115. The flower of the Rupala *montana*, the stamina of which stand on the tips of the petals.

116. Lacis *fluviatilis* has a simple flower, without calyx or corolla. It is called a flos nudus, p. 96.

117. The flower of the Ascium *coccineum*, shewing an ascidiform bractea on a foot-stalk, p. 79.

118. The flower of the Matthiola *scabra*, with an urceolated perianthium, p. 99. and a cup-shaped corolla, p. 104. which is crenated.

119. The flower of the Ruyschia *Surubea* has a sessile, bi-lobed, ascidiform bractea, p. 79.

120. The flower-bud of the same, without the ascidiform bractea.

121. The ascidiform bractea separated.

122. The flower opened.

123. The receptaculum placentiforme, p. 149. of the Dorstenia *cordifolia*, surrounded with flowers.

124. A single male flower of the same, p. 96.

125. A female flower, *ib.*

126. The flower of the Dimorpha *grandiflora*, with its singular corolla.

127. The male flower of one of the Musci frondosi with succulent filaments, p. 114. and the stamina, p. 114. of which some disperse the pollen, others are not so far advanced, and some have already shed their pollen.

128. A stamen of the Sphagnum *palustre*.

129. The same in the act of throwing out the pollen.

130. A filament with three club-shaped succulent filaments, of one of the Musci frondosi.

131. The hermaphrodite flower, of such another Moss, with pistillum and stamina.

132. The female flower of such a moss, without succulent filaments.

133. Another with succulent filaments.

FIG. 134. The flower of an Aconitum, with an irregular corolla, p. 107.

135. The pendicelled cuculli or hoods, p. 111. of the same, with stamina and pistillum.

136. The villous calyptra, p. 135. of the Polytrichum *commune*.

137. The operculum, p. 135. of the same.

138. Bryum *androgynum* has a branched surculus, p. 35; the male flowers rest upon footstalks, and are capituliform, p. 97; the thecae, p. 135. stand upon long terminal setae, p. 39; on one of them is seen a calyptra dimidiata, p. 135; another has an operculum, and one wants it.

139. The Polytrichum *commune* has a simple surculus, p. 35; the theca is covered with a hairy calyptra.

140. The bristle, p. 39. of this Moss, with the perichaetium, p. 109. and the capsule without an operculum.

141. The theca of the same Moss, with the operculum and apophysis, p. 137.

142. The same Moss, with male stellated flowers, (flos disiformis), p. 97.

143. The flower of the Senecio *vulgaris* has a double anthodium, p. 100.

144. The flower of the Sterculia *crinita* has a pedicelled germen, p. 119.

145. The flower of the Cheiranthus *annuus* has a cross-like flower, p. 106.

146. The flower of a Narcissus, with a one-flowered spatha, p. 78. a liliaceous corolla, p. 107. and a monophyllous crown, p. 113.

147. The petal of the Cheiranthus *annuus*, where the expansion, p. 108. and the claw, *ib.* are seen.

FIG. 148. The tetraphyllous perianth, p. 98. of this flower, with the pistillum and a gland, p. 110. in the bottom of the flower.

149. The style and the stamina of the same plant, to show that it belongs to the class Tetradynamia.

150. The flower of a Hypericum, having a rosaceous corolla, p. 106. the filaments united in several parcels, which is the character of the class Polyadelphia.

151. The pistillum of the same flower, with three styles, § 173.

152. The flower of the Centaurea *Verutum*, having a common thorny perianthium, p. 101. the thorns are branched.

153. The flower of the Fuchsia *excorticata*, with a funnel-shaped corolla, p. 105. a tetraphyllous crown, p. 113. and a three-lobed stigma, p. 122.

154. The same flower cut open longitudinally, to show that it belongs to the class Octandria.

PLATE VI.

155. The capsule, p. 126. of the Colchicum *autumnale*, cut over transversely. It is trilocular, p. 127.

156. The same capsule opening at the apex, p. 127. and having three valves, *ib.*

157. Two seeds of the Caucalis *daucoides*, which are prickly.

158. A single seed of the same.

159. The fruit of the Magnolia *grandiflora* has the appearance of a strobilus, p. 139. It con-

Fig. 159. sists of unilocular bivalve capsules, p. 127. that lie over one another. The seeds have a very long umbilical cord, p. 141. by which they hang down, but they are surrounded by a succulent arillus, p. 142.

160. Two seeds of the Tordylium *syriacum*, having a crenated margin.

161. The seed of the Tapsia *villosa*, with wings, p. 107. and ribs, *ib.*

162. The winged fruit, (samara, p. 125.) of the Ulmus *Americana.*

163. The same cut across, to show the position of the seed.

164. The seed of the Clematis *Vitalba*, with its tail, p. 145.

165. A transverse section of the seed of the Adonis *vernalis.*

166. A cluster of the utriculi, p. 124. of the same seeds.

167. A linear capsule of the Epilobium *montanum.*

168. A seed from this capsule, with the tuft, p. 145.

169. The same capsule burst, to show the columella, p. 126.

170. The folliculus, p. 125. of the Periploca *graeca.*

171. The kernel of the drupa of the Pterocarpa *montana* about 1-3d diminished.

172. The same drupa, p. 128. entire, likewise diminished.

173. A transverse section of the same drupa, to show the bilocular nut, p. 128.

174. The pod, (legumen, p. 133.) of the common pea.

175. The same opened, to show the character of a legumen.

176. The theca, p. 135. of the Polytrichum *commune* much magnified: on the under part is

FIG. 176. the apophysis, p. 137. which is four-cornered, with a peristoma, p. 136. having 32 teeth, closed by an epiphragma, *ib*.

177. The theca of the Tetraphis *pellucida*, having a peristoma with four teeth.

178. The theca of the Gymnostomum, with a naked peristoma, p. 136.

179. The theca of the Splachnum *ampullaceum*, with a large apophysis, and a peristoma with eight teeth.

180. A Grimmia, having a peristoma with sixteen teeth.

181. A Neckera, with a double row of teeth at the peristoma.

182. A Dicranum, with a peristoma having sixteen bifid teeth, p. 136.

183. A Trichostomum, with the same sort of peristoma, only the teeth are much more deeply divided.

184. A Barbula, with twisted teeth at the peristoma, p. 136.

185. A seed with a pappus supported on a foot-stalk, p. 143; the pappus is plumose, p. 145.

186. A seed with a hairy pappus, p. 144. supported on a foot-stalk.

187. A silicle, p. 132.

188. The partition, p. 132. of the same, with seeds attached to it.

189. A seed with a sessile pappus, p. 143. which is setaceous, p. 144.

190. A siliqua, p. 132. burst, so that the partition is seen.

191. The same shut.

192. The loment, p. 134. of the Cassia *Fistula*.

193. The strobile, p. 139. of the Pinus *picea*, much less than the natural size.

FIG. 194. The loment of the Cassia *Fistula* opened, to show the character of it.

PLATE VII.

195. The flower of the Helleborus *niger*; it is rosaceous, p. 106. and belongs to the class Polyandria.

196. The nectarium of this flower, which is a cucullus, p. 111.

197. The heart-shaped oblique leaf, p. 54. of the Begonia *nitida*. The margin is undulated, p. 57. The veins are so divided that it is venoso-nerved, p. 59.

198. A venoso-nerved leaf, p. 59.

199. A leafy capitulum, p. 41. of the Gomphrena *globosa*.

200. A three-nerved leaf, p. 59.

201. A quintuple-nerved leaf, p. 59.

202. A septuple-nerved leaf, p. 59.

203. A crenated, p. 57. heart-shaped leaf, which is seven-nerved, p. 59.

204. The entire drupa, p. 128. of the Nutmeg, Myristica *moschata*.

205. The common Acorn, which is a nut, p. 128.

206. The nut of the Myristica *moschata*, surrounded with what is called Mace, which is properly a torn arillus, p. 142.

207. A folium triternatum, p. 61.

208. The Hovenia *dulcis*, with flower-stalk, which changes into a fleshy esculent receptacle, p. 148.

209. The nut of the Myristica *moschata*, without the arillus.

FIG. 210. The fruit of the Passiflora *foetida*, with its perianthium abiding, p. 98.

211. The nut of the Myristica cut across, to show the kernel, p. 128.

212. The succulent fruit or pumpkin, p. 131. of the Passiflora *foetida*, cut up longitudinally.

213. The strawberry, Fragaria *vesca*, having a fleshy receptacle, p. 148. and bearing naked seeds.

214. The fruit of the Cashew-nut tree, Anacardium *occidentale*, with a pear-shaped fleshy receptacle, p. 148. and a nut, p. 128.

215. Gomphia *Japotapita* has a fleshy receptacle, p. 148. bearing berries, p. 129.

216. Semicarpus *Anacardium* has a fleshy receptacle and a nut.

217. The leaf of the Mimosa *unguis cati* is a folium bigeminatum, p. 61.

218. A flat receptacle, p. 149. which is punctured, p. 150.

219. The common fig has a closed receptacle, p. 149.

220. The same cut up longitudinally, to show the flowers.

221. A conicle receptacle, p. 149.

222. A folium conjugato-pinnatum, p. 63.

PLATE VIII.

223. The Boletus *bovinus* is a fungus, p. 179. with a naked stipes, p. 34. a round pileus, p. 83. and pores on the under surface, p. 84.

224. The Hydnum *imbricatum*, a fungus, with prickles, p. 85. on the under surface of the pileus.

225. The Agaricus *integer*, a fungus with lamellae, p. 84. on the under side of the pileus.

FIG. 226. The Peltigera *canina*, an Alga, p. 179. with a coriaceous frons, p. 74. and targets, p. 151.

227. The Jungermania *resupinata* belongs to the Musci hepatici, p. 179. and has a four-valved capsule.

228. An Euphorbia, with verrucose leaves, p. 66.

229. The Berkheya *ciliaris*, with imbricated leaves, p. 67. which are ciliated.

230. The Mesembryanthemum *uncinatum*, with a hook-shaped leaf, p. 66.

231. The Mesembryanthemum *deltoideum*, with a deltoid leaf, p. 66.

232. A scimetar-shaped leaf, p. 65.

233. An articulated stem, p. 31.

234. A folium trigeminatum, p. 61. of the Mimosa *trigemina*.

235. A half-round stem, p. 30.

236. A three-sided stem, p. 30.

237. A four-angled stem, p. 30.

238. A spatulate leaf, p. 54.

239. A jointedly pinnate leaf, p. 63. of the Fagara *Pterota*.

240. A decursively pinnate leaf, p. 63. of the Melianthus *major*.

241. A doubly compound leaf, p. 63. of the Aegopodium *podagraria*.

242. A folium runcinatum, p. 56.

243. A folium lyratum, p. 56.

244. A folium dolabriforme, p. 65.

245. A folium parabolicum, p. 54.

246. A folium pedatum, p. 62. of the Helleborus *niger*.

247. A folium tripinnatum, p. 63.

248. The leaf of the Ulmus *campestris*, unequal, p. 53. and duplicato-dentate, p. 57.

249. A folium bipinnatum, p. 63.

FIG. 250. A gemma convoluta, p. 90.
251. A gemma involuta, p. 89.
252. A gemma revoluta, p. 89.
253. A gemma conduplicata, p. 90.
254, 255. A gemma equitans, p. 90.
256. A gemma obvoluta, p. 89.
257. A gemma plicata, p. 90.
258. A doubly convoluted gemma, p. 90.
259, 260. A doubly involuted gemma, p. 90.
261. An operculum, p. 135. with the fringe, p. 136.
262. A doubly revolute gemma, p. 90.
263, 264. A gemma equitans, p. 90.
265. A folium squarroso-laciniatum, which is also decurrent, p. 68. and has a winged stalk, p. 29.
266. A corymbus, p. 47.
267. A salver-shaped corolla, p. 105.
268. A spherical corolla, p. 104.
269. A funnel-shaped corolla, p. 105.
270. A doubled common perianthium, 102.
571. A ligulate corolla, p. 105. of the Aristolochia *Clematitis*.
272. A bilabiate corolla, p. 106.
273. A cup-shaped corolla, p. 104.
274. An urceolated corolla, p. 105.
275. A tubular corolla, p. 104.
276. A club-shaped corolla, p. 104.
277. A simple spike, p. 43.
278. A simple racemus, p. 45.

PLATE IX.

279. A section of the cuticle of the Lilium *chalcedonicum*, much magnified, to show the openings; with the lymphatic vessels, § 236.

FIG. 280. A section of the cuticle of the Allium *Cepa*, the common onion, much magnified, to show the openings and the lymphatic vessels, § 236.

281. A section of the cuticle of Dianthus *Caryophyllus*, common pink, much magnified, to show the same.

282. Three air-vessels, § 235. much magnified.

283. The capsules of the Octospora *pustulata* much magnified, in which are seen two seeds in each membrane, p. 127.

284. The Octospora *pustulata* of its natural size.

285. A folium digitato-pinnatum, p. 63. of the Mimosa *pudica*, the Sensitive plant.

286. The Octospora *villosa* of its natural size.

287. The capsules of the same much magnified, to show the eight seeds.

288. The young stalk of the Utricularia *vulgaris*, with the roots, at which hang the little bladders, p. 80.

289. A branch of the common Oak, having sinuated leaves, p. 56. with the ramenta, p. 76. between them.

290. A folium triplinervium, p. 59.

291. The flowering umbel of a Cyperus, on the principal peduncle of which is to be seen an ochrea, p. 79.

292. A folium auriculatum, p. 53.

PLATE X.

293. The Pteris *longifolia* has a pinnated frons, p. 72. linear masses *(sori)*, p. 49. which are marginal, p. 50. and continued, *ib.* The cover, p. 86. is continuous, p. 87. and marginal, *ib.*

294. The bivalve capsule, p. 128. of a fern.

FIG. 295. The annulated capsule, p. 128. of a fern, which is already burst.

296. The same still close.

297. The two-rowed sori, p. 50. which stand transversely on the apex of the frond of the Danaea *nodosa* of their natural size.

298. The Polypodium *Otites*, diminished, has a frond with confluent pinnae, p. 73. on the back of which are the subrotund sori, p. 49.

299. Cribraria *vulgaris*, of its natural size, a Gasteromycus, p. 179.

300. Lycopus *europaeus*, has laciniated leaves, p. 55. that stand opposite, p. 66. and has its flowers in a sessile whirl, p. 40.

301. Cribraria *vulgaris*, much magnified, with the envelope, p. 85. circularly torn, p. 86. by which means the Hair-net, p. 147. is brought into view.

302. The same Gasteromycus, p. 179. with the envelope already loose, but which is still full of seeds.

303. Two transverse sori of the frond of Danaea *nodosa* magnified, where the capsules are grown together, and separate, showing the cleft.

304. Lichen *gracilis*, has a cup-bearing frond, p. 75.

305. Osmunda *cinnamomea* diminished, the fertile frond, p. 73. is pinnated, the unfertile bipinnatifid, *ib*.

306. The under side of the calyx of a flower of Pelargonium that is tranversely cut over to show the tube, p. 112.

107. The whole flower of a Pelargonium, where the course of the tube to the flower-stalk is observable. The corolla is irregular, p. 107.

308. The Erythroxylon *Coca* has a veined leaf, and lateral peduncles, p. 38.

FIG. 309. The flower of the Melia *Azedarach* bears a cylinder, p. 113.

310. The cylinder of the same flower, to show the anthers.

PLATE XI.

Contains the various colours which are described at p. 222. The scale at the foot is used for the various measures of plants mentioned in p. 11.

INDEX

TO THE

LATIN TERMS.

Abbreviatum perianthium . . 99
abortus . . 400
abrupte pinnatum folium 62
acaulis pileus . . 83
acaulis planta . . 32
acerosae arbores . . 298
acerosum folium . . 55
aciculares pili . . 94
acinaciforme folium . 65
acinus . . 130
acotyledones . . 141
aculeatum folium . . 58
aculeatus caudex . . 23
aculeatus caulis . . 29
aculeatus stipes . . 34
aculeus . . 84, 92
acuminata ligula . . 80
acuminatum folium . . 51
acuminatum operculum 135
acuta ligula . . 80
acutangulatus caulis . 30
acutum folium . . 51
acutum operculum . 135
acutum stigma . . 121
Adansonii systemata . 168
adducentia vasa . . 268
adductores . . 123
adnata anthera . . 118
adpressum folium . . 69
adversum folium . . 69
aequale anthodium . 101
aequales lamellae . 84
aequalia filamenta . 116
aequalis polygamia . 174
aequivoca generatio . 354
aeruginosus . . 223
aestivatio . . 10
afora pericarpia . . 164
aggregata gemma . . 90
aggregata seta . . 39
aggregata radix . . 20
aggregatae . . 184
ala . . 107, 140
alaris pedunculus . 38
alata drupa . . 129
alatus caulis . . 29
alatus petiolus . . 37
albidus . . 224
albigo . . 374
albo-marginatum folium 228
albo-variegatum folium 228
alburnum . . 251
albus . . 224
algae . . 179, 154
allagostemon . . 169
alterna folia . . 66
alternatim pinnatum folium 62
alterni rami . . 25
amentaceae . . 184
amentum . . 49
amnios . . 361
amplexicaule folium . 68
ampulla . . 80
anasarca . . 380

anastomosis . . 274
anceps caulis . . 30
anceps folium . . 65
androgyna dichogamia . 344
angiospermia . . 173
angiospermia vegetabilia 124
angulata anthera . . 117
angulatus caulis . . 30
angulosum stigma . . 122
angulus . . 71
animalcula spermatica . 354
annuae plantae . . 155
annulata radix . . 17
annulata capsula . . 128
annulatus caudex . . 23
annulus . 82, 128, 136
anomalae . . 163
anthera . . 116
anthesis . . 10
anthodium . . 100
apetalae . . 170
apetalus flos . . 96
aphyllus caulis . . 29
aphyllus flos . . 96
aphyllus verticillus . 40
apice cohaerentes dentes 137
apice dehiscens anthera 117
apice dehiscens capsula 127
apiculatum receptaculum 170
apophysis . . 137
approximata folia . . 67
arachnoideus annulus . 82
arbores . 156, 297
arboreus truncus . 24
argenteo marginatum folium 228
argenteo-variegatum folium 228
arillus . . 142
arista . . 93
aristata anthera . 117
aristata vavula . . 101
aristatus pappus . . 144
arrhizoblastae . . 284
artificiale systema . 154
articulata radix . 19
articulate-pinnatum folium 63
articulati pili . . 94
articulatum filamentum 115
articulatum folium . 65
articulatum lomentum 134
articulatus caulis . 31
arundinaceae . . 163
ascendens caudex . . 13
ascendens caulis . . 27
ascidiformes bracteae . 79
ascidium . . 79
asper . . 8
asperifoliae . . 183
ater . . 224
atropurpureus . 224
atrovirens . . 222
attenuatum amentum . 49
auctum anthodium . 102
aurantiacus . . 223
auratum folium . 228
aureo-variegatum folium 228
aureus . . 223
auriculae . . 76
auriculatum folium . 53
avenium folium . 60
axillare capitulum . 41
axillare folium . . 64
axillaris cirrhus . . 88
axillaris pedunculus . 38
axillaris seta . . 39
axillaris spica . . 44
axillaris spina . . 92
azureus . . 222

Bacca . . 129
baccata capsula . 127
baccata drupa . . 128
baccata silicula . . 132
baccatus arillus . . 142
bacciferae . . 160
badius . . 223
barba . . 109, 113
barbatus . . 9
basi dehiscens capsula . 127
basis . . 147
bedeguar . . 379
bialata ala . . 146
bicornes . . 181
bicornis anthera . 117
bidentatum perianthium . 98
biennes plantae . . 156
bifariam imbricata folia . 67
bifida anthera . . 117
bifida ligula . . 80
bifidi dentes . . 136
bifidum filamentum . 115
bifidum folium . 52
bifidum perianthium . 98
bifidum stigma . . 122
bifidus cirrhus . . 88
bifidus stylus . . 120
biflora spatha . . 78
biflora spicula . . 42
biflorus pedunculus . 37
bifora pericarpia . . 165
bigeminatum folium . 61
bijugum pinnatum folium 71
bigeminum folium . . 61
bilabiata corolla . . 106
bilabiatum perianthium . 99

bilobum folium . . 55
biloculare folium . 65
biloculare semen . . 141
bilocularis anthera . . 117
bilocularis bacca . . 130
bilocularis capsula . . 127
bilocularis nux . . 128
bilocularis pepo . . 131
binatum folium . . 61
bipartitum perianthium . 99
bipinnata frons . . 72
bipinnatifida frons . . 73
bipinnatum folium . . 63
biseriales lamellae . . 84
biserialis sorus . . 50
biternatum folium . . 61
bivalve indusium . . 87
bivalvis capsula . 127, 128
bivalvis gluma . . 100
bivalvis spatha . . 78
bivasculares . . 161
Boerhavii systema . 162
brachiatus caulis . 26
brachium . . 12
bracteae . . 77
bracteatus racemus . 45
bracteatus verticillus . 40
brunneus . . 223
bulbifer caulis . . 29
bulbosa radix . . 19
bulbosi pili . . 94
bulbosus caudex intermedius 21
bulbosus stipes . . 35
bulbus . . 15
bullatum folium . . 58
byssacea radix . . 20

Caducae stipulae . . 76
caducum perianthium . 98
caducus pappus . . 143
Caesalpini systema . 158
caesius . . 222
calcar . . 112
calmariae . . 180
calycanthemae . 181
calyciflorae . . 181
calyciforme involucrum . 81
calycostemon . . 169
calycostemonis . . 168
calyculatum anthodium 102
calyculatus pappus . 143
calyptra . 109, 127, 135
calyptratus arillus . 142
calyx . . 97
cambium . . 332
Camelli systema . 164
campanaceae . . 182
campanulata corolla . 104
campanulatus pileus . 83
canaliculatum folium . 58
canaliculatum legumen . 133
canaliculatus petiolus . 37
candidus . . 224
canus . . 224
capillare filamentum . 115
capillare folium . . 54
capillares . . 160
capillaris pappus . . 144
capillaris radix . . 18
capillaris stylus . . 120
capillitium . . 147
capillus . . 11
capitatae . . 163
capitatum stigma . . 121
capitatus verticillus . 40
capituliformis flos . 97
capitulum . . 41
caprificatio . . 11
capsula . . 126
carcinoma arborum . 385
carina . . 107
carinatum folium . 60
carneus . . 223
carnosa pepo . 131
carnosa radix . . 15
carnosum folium . . 65
carnosum legumen . 133
carnosum receptaculum 148
carnosus caulis . 31
carnosus arillus . . 142
carnosus stipes . . 34
cartilagineum folium . 57
cartilagineus arillus . 142
caryophyllacea corolla . 106
caryophylleae . . 182
catenula . . 147
cauda . . 145
caudex . . 23
cauliformis caudex intermedius 22
caulinum folium . . 64
caulis . . 24
cava radix . . 15
centralis radix . . 20
cernuus caulis . . 27
cernuus racemus . . 45
character . . 188
chlorosis . . 379
chorion . . 360
cicatrisata radix . . 17
cicatrisatus caudex intermedius 22
cicatrisatus caulis . 32
ciliata spica . . 44

ciliata ligula . . 80
ciliato-dentatum peristoma 137
ciliatum anthodium . 101
ciliatum folium . . 57
ciliatus . . 9
ciliatus pappus . . 144
cinereus . . 224
cinnabarinus . . 223
circinata gemma . . 90
circinnatus aculeus . . 92
circumscissa capsula . 127
circumscissum peridium . 86
circumscissus utriculus . 125
cirrhosum folium . 88
cirrhosum pinnatum folium 88
cirrhus . . 88
cistella . . 151
classis . . 156
clausum perianthium . 99
clausum receptaculum . 149
clavata corolla . . 104
clavatum stigma . . 121
clavatus stylus . . 120
clavus . . 397
coadunatae . . 184
coarctatus caulis . 26
coarctata panicula . 48
coccineus . . 223
cochleatum legumen . 134
coeruleus . . 222
color . . . 222
colorata gluma . . 100
coloratae bracteae . 77
coloratum folium . 60
coloratum perianthium . 100
columella . . 126
columniferae . . 183
columnula . . 137
coma . . 77, 145
comosa spica . . 44
comosum capitulum . 41
commune receptaculum . 148
communis calyx . . 102
communis corolla . . 95
communis flos . . 95
communis pedunculus . 37
communis petiolus . 37
composita bacca . . 130
composita radix . 20
composita spica . . 44
composita umbella . 46
compositae . . 184
compositi irregulares flores 165
compositi regulares flores 165
compositi regulares et irregulares flores . . 165
compositus flos . . 95
compositum folium . 60
compositus racemus . 45
compressa glandula . 110
compressum folium . 65
compressum legumen . 133
compressus caulis . 30
compressus petiolus . 37
concavum folium . 58
concavum stigma . 122
concavus pileus . . 83
conductor fructificationis 343
conduplicata gemma . 90
conferta folia . . 67
conferta umbella . . 46
confertus caulis . . 26
confertus verticillus . 40
conglobata radix . 19
congregatae . 170
conicum capitulum . 41
conicum operculum . 135
conicum receptaculum . 149
conicus strobilus . . 139
coniferae . . 184
conjugata spica . . 44
conjugato pinnatum folium 63
conjugatum folium . 61
conjugatus racemus . 45
connata filamenta . 115
connatae antherae . 118
connatae stipulae . 76
connatum folium . . 68
conniventia filamenta . 116
contextus cellulosus . 270
continuus sorus . . 50
continuum indusium . . 87
contorsiones . . 377
contortae . . 182
contorti dentes . . 136
contractilitas . . 247
convexa umbella . . 47
convexum folium . . 60
convexum operculum . 135
convexum receptaculum . 148
convexus pileus . . 83
convoluta gemma . . 90
convolutum stigma . . 122
convolutus cirrhus . . 88
corculum . . 140
cordatum filamentum . 115
cordatum folium . . 52
coriacea frons . . 74
coriaceum legumen . . 133
coriaceus stipes . . 34
cormus . . . 22
corniculatum filum . . 113

corniculatum indusium . 86
cornu . . 146
corolla . . 104
corollaceus flos . . 96
corona . . 113
coronariae . . 181
cortex . . 251
corticata capsula . . 127
corticosa bacca . . 130
corticosa pepo . . 181
corticosum lomentum . 134
cortina . . 82
corydales . . . 182
corymbiferae . . 159
corymbus . . 47
costa . . 147
costatum folium . . 58
cotyledon . . . 140
crassus stylus . . 120
crenatum folium . . 57
crispum folium . . 58
crista 146
cristata anthera . . 117
croceus . . . 223
cruciata corolla . . 106
cruciforme stigma . . 122
crustacea frons . . 74
cryptogamia . . 171
cryptostemon . . 169
cryptostemonis . . 169
cubitus . . 12
cucullata corona . . 113
cucullatum folium . . 60
cucullus . . . 111
cucurbitaceae . . 183
culmiferae . . 159
culmus . . . 32
cuneiforme filamentum . 115
cuneiforme folium . . 52
cuspidatum folium . . 51
cutis 251
cyaneus . . . 222
cyathiformis corolla . 104
cyathiformis fungus . . 85
cyathiformis glandula . 111
cylindracea radix . 16
cylindrica spica . . 44
cylindricum amentum . 49
cylindricum anthodium . 102
cylindricus strobilus . 139
cylindrus . . 113
cyma . . 47
cyphilla . . 85

Daedaleum folium . . 52
debilis caulis . . 27
debilitas . . 383
decandria . . 171
decemflorus verticillus . 41
deciduae stipulae . . 76
deciduum perianthium . 98
deciduus stylus . . 121
declinata filamenta . . 116
declinatus caulis . . 27
declinatus stylus . . 121
decompositum folium . 63
decumbens caulis . . 28
decurrens folium . . 68
decurrens ligula . . 80
decurrentes lamellae . 84
decussata folia . . 67
decussive pinnatum folium 63
deflexis ramis surculus . 35
deflexus caulis . . 26
defoliatio . . 10
defoliatio notha . . 371
dehiscens drupa . . 129
dehiscens peridium . . 86
deliquescens caulis . . 25
deliquium . . 383
deltoides folium . . 66
demersum folium . . 70
demersus caulis . . 28
dendroides surculus . . 35
dentata anthera . . . 117
dentata calyptra . . 135
dentata radix . . 16
dentato-crenatum folium . 57
dentato-dehiscens peridium 86
dentatum folium . . 57
dentatum perianthium . 98
dentatum stigma . . 122
dentes bifidi . . 136
dentes contorti . . 136
denticulati pili . . 94
depauperata umbella . 47
dependens folium . . 69
dependens involucrum . 81
depressum folium . . 65
dermoblastae . . 282
descriptio . . 219
descendens caudex . 13
dextrorsum volubilis caulis 29
diadelphia . . . 171
diagnosis . . . 219
diandria . . . 171
diantherae . . . 169
dichogamia . . . 344
dichotomum folium . 55
dichotomus caulis . . 25
dichotomus stylus . . 120
dicotyledones . . 141

didyma anthera . . 116
didynamia . . 171
differens structura . . 191
difformis corolla . . 105
difformis flos . . 395
difformis pappus . . 145
digitata radix . . 181
digitato-pinnatum folium 63
digitatum folium . . 61
digynia . . 173
dilatatum filamentum . 115
dimidiata calyptra . 135
dimidiata spatha . . 78
dimidiatum capitulum . 41
dimidiatum involucrum . 81
dimidiatus arillus . 142
dimidiatus pappus . 144
dimidiatus pileus . 83
dimidiatus verticillus . 40
dioecia . . 175
dipetala corolla . . 107
dipetalae . . 163
dipetali irregulares flores 165
dipetali regulares flores . 165
diphylla corona . . 113
diphyllum involucrum . 81
diphyllum perianthium . 98
diphyllus pappus . . 144
diplostemones . . 170
dipterigia ala . . 146
dipyrena bacca . . 130
dipyrena drupa . . 129
disciformis flos . . 97
discoideae . . 163
discoideus flos . . 96
discus . . . 96
disparia folia . . 66
disperma bacca . . 130
disperma capsula . . 127
disperma nux . . 128
disperma vegetabilia . 124
dispermum legumen . 133
disseminatio . . 11
dissepimentum . 126, 132
dissimilis pappus . . 145
distans verticillus . 40
disticha folia . . 67
disticha spica . . 44
disticha spicula . . 43
distichus caulis . . 25
divaricatus caulis . . 26
divergens caulis . . 326
divisa radix . . 20
divisa spina . . 92
dodecandria . . 171
dodrans . . 12
dolabriforme folium . . 65
dorsalis arista . . 93
dorsiflorae filices . . 155
drupa . . . 128
drupacea silicula . . 132
dumosae . . . 184
duplex corolla . . 359
duplex perianthium . 98
duplex peridium . 85
duplex indusium . 87
duplex volva . . 82
duplicato-dentatum folium 57
duplicato-pinnatum folium 63
duplicato-ternatum folium 61
durum putamen . . 128

Ebracteatus racemus . 45
ebracteatus verticillus . 40
echini . . 85
eglandulosus petiolus . 37
elasticitas . . . 247
elater . . 147
ellipticum folium . . 53
emarginatum folium . 52
emarginatum stigma . 121
embryo . . 360
emersum folium . . 70
enervium folium . . 59
enneandria . . 171
enodis caulis . . 31
enodis culmus . . 32
ensatae . . 180
ensiforme folium . . 54
epicarpius flos . . 120
epidemicus morbus . 367
epidermis . . 251
epigenesis . . 356
epiphragma . . 137
epiphyllospermae . . 155
equitans folium . . 68
equitans gemma . . 90
erecta anthera . . 118
erectum folium . . 69
erectus annulus . . 82
erectus caulis . . 27
erectus culmus . . 33
erectus racemus . . 45
erectus surculus . . 36
erosum folium . . 57
essentialis character . . 188
evanescens radix . . 21
exasperata seta . . 39
exstipulatus caulis . . 29
exsucca bacca . . 130
exsucca drupa . . 129
exsucca pepo . . 131

5

exterius dehiscens indusium . 87
externum perigonium . 196
extrafoliaceae stipulae . . 76
extrafoliaceus pedunculus . 38
exulceratio . . . 384

Factitius character . . . 188
farinosum legumen . . 133
farinosus . . . 9
fasciculata folia . . 67
fasciculata radix . . 18
fasciculata spica . . 44
fasciculatum lignum . 250
fasciculus . . . 46
fastigiatus caulis . . 26
faux 108
favosum receptaculum . 150
ferrugineus . . . 223
fibra vegetabilis . 272
fibrillae . . 14
fibrillata radix . . 18
fibrosa drupa . . 128
fibrosa radix . . 18
fibrosus caulis . . 31
figura . . . 191
figuratum peristoma . 136
fila succulenta . . 114
filamentosa frons . 74
filamentum . . 115
filices . . . 155, 179
filiforme filamentum . 115
filiformis radix . . 18
filiformis stylus . . 120
filum . . . 113
fimbria . . 128, 136
fissa radix . . 18
fissura . . . 370
fissum folium . . . 52
fissum perianthium . . 98
fistulosus caulis . . 31
fistulosus stipes . . 34
flabelliforme folium . . 52
flabelliformis frons . . 72
flavo virens . . . 223
flexilis caulis . . 27
flexuosus caulis . . 28
florale folium . . 64
floriferae . . 163
floriferae gemmae . 89
flos . . . 95
flosculosus flos . . 96
fluitans surculus . . 36
foemineus flos . . 96
foliacea frons . . 73
foliacea ochrea . . 79
foliaris cirrhus . . 88
foliatio . . . 89
foliatus racemus . . 45
foliifero-floriferae gemmae 89
foliolis decrescentibus pinnatum folium . . 63
foliolum . . 100, 71
foliosa spica . . 44
foliosum capitulum . . 41
foliosus caulis . . 29
foliosus verticillus . 40
folia . . . 50
folliculus . . . 125
folliculus carnosus foliorum 377
fornix 112
fovea 112
fractura 369
fragile putamen . . 128
fragilis caulis . . 27
frondescentia . . . 10
frondosi musci . . 154
frondosus culmus . . 33
frons . . . 71
fructificans caulis . . 30
fructificatio . . . 10
fructificationis partes . 14
fructus . . 123
frustranea polygamia . 174
frutescentia lilia . . 298
frutices . . 156, 297
frutices minores . . 298
fruticosa gramina . . 298
fruticosus truncus . . 24
fruticulosa frons . . 74
fugax annulus . . 82
fugax pappus . . 143
fulcra 75
fulcratus caulis . . 27
fungi . . 179, 154
funiculus umbilicalis . 141
furcati pili . . . 94
fuscus 223
fusiformis radix . . 16

Galea . . . 108
galeatae . . . 160
galla . . . 376
gangraena . . . 387
gasteromyci . . 179
gelatinosa frons . . 74
geminae stipulae . . 75
geminata radix . . 20
geminatus aculeus . . 92
geminatus pappus . . 145
gemma . . . 89
gemmiformis flos . . 97
genericum nomen . . 233

geniculata arista . . 93
geniculata radix . . 16
geniculatus caulis . . 31
geniculatus culmus . 33
genus . . 156, 188
geoblastae . . 284
germen . . . 119
germinatio . . . 10
gibbosum folium . . 65
gibbum folium . . 65
glaber . . . 8
glabrum receptaculum . 149
glandula . 273, 91, 110
glandulosus petiolus . 37
glaucus . . . 223
Gleditschii systema . 168
globosa anthera . . 116
globosa corolla . . 104
globosa glandula . . 110
globosa radix . . 16
globosum anthodium . 102
globosum capitulum . 41
globosum receptaculum . 148
globosum stigma . . 121
globosus fungus . . 85
globosus strobilus . . 139
globulus . . 97
glochis . . 95
glomerata spica . . 43
glomerulus . . 97
gluma . . 100
glutinosus . . 9
gongylus . . 91
gracile amentum . . 49
gramina . . 155, 180
granulata radix . . 18
griseus . . . 224
grossificatio . . 11
gruinales . . 181
gymnospermae . . 123
gymnospermia . . 173
gymnospermia vegetabilia 123
gynandra dichogamia . 315
gynandria . . 171
gyroma . . 151

Habitus . . 41
Halleri systema . . 170
haemorrhagia . . 372
hamus . . 95
hastatum folium . . 53
hederaceae . . . 184
hemisphaericum anthodium 102
hemisphaericum capitulum 41
hepaticae . . 178
hepatici musci . 154, 179
hepaticus . . 223
heptandria . . 171
herbaceus caulis . . 31
herbae . . . 155
herbarium . . 4
Hermanni systema . 161
hermaphroditus flos . 96
hesperides . . 181
heteroclitae . . 159
hexafora pericarpia . 165
hexagonus caulis . 31
hexandria . . 171
hexapetali irregulares flores 165
hexapetali regulares flores 165
hilum . . . 141
hirtus . . . 8
hispidus . . . 8
holoraceae . . . 181
homogamia . . . 344
horizontale folium . . 69
horizontalis radix . . 17
humifusus caulis . . 28
hyalinus . . . 224
hydropterides . . 179
hypocarpius flos . . 120
hypocrateriformis corolla 105

Icosandria . . 171
icterus . . . 380
imbricata folia . . 67
imbricata frons . . 74
imbricata radix . . 19
imbricata spica . . 43
imbricatum anthodium . 101
impari pinnatum folium . 62
inaequale folium . . 53
inaequales lamellae . . 84
inaequalia filamenta . . 116
inanis caulis . . 31
incompleti flores . . 166
incumbens anthera . . 118
incurvum filamentum . 116
incurvum folium . . 69
incurvus aculeus . . 92
indicans macula . . 345
indivisum folium . . 55
indusium . . . 86
inermis caudex . . 23
inermis caulis . . 30
inferius labium . . 109
inferum germen . . 120
inferus flos . . 120
inflatum perianthium . 99
inflatus petiolus . . 37
inflexum folium . . 69
inflorescentia . . 39
infractus culmus . . 33
infundibuliformis corolla 105

integer caulis . . 25
integer pappus . . 143
integerrimum folium . 56
integra calyptra . . 135
integra ligula . . 80
integra radix . . 16
integrum folium . . 55
integrum perianthium . 99
intermedius caudex . . 21
intermedium perigonium . 196
internum perigonium . . 196
interrupta spica . . 43
interruptae lamellae . . 84
interrupte-pinnatum folium 62
interruptus sorus . . 50
interius dehisceus indusium 87
intrafoliaceae stipulae . 76
intrafoliaceus pedunculus 38
intricatus surculus . . 35
inundatae 181
inversus annulus . . 82
involucratus pedunculus . 81
involucrum . . . 80
involuta gemma . . 89
irregularis corolla . . 107
isostemones . . . 170
isthmis interceptum lomentum 134
jugum . . 147
juliferae . . 162
julus 49

Knautii systema . . 162

Labellum . . . 109
labiatum perianthium . 99
labium . . 109
lacera ligula . . 80
lacerus arillus . . 142
lacinia . . 108, 100, 70
laciniatum folium . . 55
lactescentes . . . 159
lacteus 224
lacunosum folium . . 58
lacunosus stipes . . 34
laevis . . . 7
laevis caudex intermedius 22
laevis radix . . . 18
laevis seta . . . 39
lamellae . . . 84
lamina . . . 108
lana 95
lanatus . . . 8
lanceolatum folium . . 54
laterale stigma . . 123
laterales stipulae . . 75
lateralis anthera . . 118
lateralis radix . . . 20
lateralis pedunculus . . 38
lateralis spica . . 44
lateralis stylus . . 121
latere dehiscens anthera . 117
laterifolius pedunculus . 38
lateritius . . . 223
laxus caulis . . . 27
laxus racemus . . . 45
laxus utriculus . . . 124
legumen . . . 133
leguminosae . . 159
lepidotus . . . 9
lepra . . . 375
levis . . . 7
libera anthera . . 118
liber . . . 251
liberum filamentum . . 115
lignosa capsula . . 127
lignosa radix . . 15
lignosum legumen . . 133
lignosus caulis . . 31
lignum . . 251
ligula . . . 80
ligulata corolla . . 105
lilacinus . . 224
lilia . . . 155
liliacea corolla . . 107
limbus . . 108
linea . . . 11
lineare folium . . 54
linearis anthera . . 116
linearis spica . . 44
linearis spicula . . 43
linearis sorus . . 50
lineatum folium . . 59
linguiforme folium . . 66
Linnaei systema . . 171
lirella . . . 151
lividus . . . 224
lobatum folium . . 55
lobus . . 108, 70
loculamenta . . 126
loculosa radix . . 16
loculosum folium . . 65
locusta . . . 42
lomentaceae . . 183
lomentum . . 134
longitudinalis sorus . 50
lunatum folium . . 53
lunatus sorus . . 49
luridae . . 182
lymphatica vasa . 269
lyratum folium . . 56

Magnolii systema . . 168

malvacea corolla . . . 106
marcescens perianthium . 98
marcescens spatha . 78
marcescens stylus . 121
marginale indusium . . 87
marginatus pappus . . 143
margo membranaceus . 146
masculus flos . . 96
maturatio . . 11
medulla . . 251
mejostemones . . 170
melligo . . 374
membrana interna . . 141
membranacea valvula . . 101
membranaceo-dentatum peristoma . . 187
membranaceum folium . 64
membranaceum legumen 133
membranaceus arillus . 142
membranaceus caulis . 31
membranaceus margo . . 146
methodus . . 186
miniatus . . . 223
miscellaneae . . 185
mobilis annulus . 82
Moenchii systema . . 169
molendinacea semina . . 146
monadelphia . . . 174
monandria . . . 171
monantherae . . . 169
moniliformis radix . 19
monocotyledones . . 141
monoecia . . 175
monogamia syngenesia 174
monogynia . . . 173
monopetala-corolla . 104
monopetalae . . 163
monopetali irregulares flores 165
monopetali regulares flores 165
monophylla corona . . 113
monophyllum anthodium 101
monophyllum perianthium 98
monopterigia ala . 146
monopyrena drupa . 129
monosperma bacca . 130
monosperma vegetabilia 124
monospermum legumen 133
monstrositas . . 389
monstrum . . . 213
Morisoni systema . 159
mucronatum folium . 51
mucronatum operculum 135
multangularis caulis . 30
multialata ala . . 146
multicapsulares . . . 160
multiceps radix . . . 17
multidentatum perianthium 98
multifidum filamentum . . . 115
multifidum folium . . 52
multifidum perianthium . . 98
multifidum stigma . 122
multifidus cirrhus . . 88
multifidus stylus . . . 120
multiflora spatha . . 78
multiflora spicula . . . 42
multiflorus verticillus . . 41
multilocularis bacca . . . 130
multilocularis capsula . . 127
multilocularis nux . . 128
multilocularis pepo . . 131
multipartitum perianthium 99
multiplicatus flos . . . 390
multisiliquae . . . 182
multivalvis capsula . . 127
multivalvis gluma . . 100
muricatum anthodium . 101
muricatus . . . 9
musci 154, 179
mutica-anthera . . . 117
mutica valvula . . 101
mutilatio . . . 388

Napiformis caudex intermedius 21
napiformis radix . . . 16
natans caulis . . . 28
natans folium . . . 69
naturale systema . 154
naturalis character . . 188
naturalissima structura . . 191
necessaria polygamia . 174
necrosis . . 386
nectariferae squamae . . 110
nectariferi pori . . 110
nectarium . . . 110
nemoblastae . . 283
nervosum folium . 59
nidulans radix . . 19
neuter flos . . . 96
nidulantia semina . 141
niger 224
nitidus . . 7
nodosi pili . . . 94
nodosus caulis . . 31
nodosus culmus . . 32
non cohaerentes dentes . . 136
non umbilicatae arbores . 163
notha radix . . . 20
nucleus . . . 128

nuda arista . . 93
nudum capitulum . . 41
nudum peristoma . 136
nudus caulis . . 29
nudus culmus . . . 33
nudus flos . . . 96
nudus racemus . . . 45
nudus stipes . . 34
nudus verticillus . 41
nullum peristoma . 137
numerus . . . 191
nutans caulis . . 28
nutans racemus . 46
nux 128

Obcordatum folium . 70
obliqua Ochrea . . 79
obliqua radix . . . 17
obliquum folium . 69
obliquus culmus . . 33
oblonga anthera . . 116
oblonga glandula . 111
oblonga spicula . . 43
oblongum folium . . 53
oblongum stigma . . 121
obtuse angulatus caulis . 30
obtusum folium . . 51
obtusum stigma . 121
obovatum folium . . 70
obvoluta gemma . 89
ochraceus . . . 223
ochrea . . . 79
octandria . . 171
octodentatum peristoma 136
octoflorus verticillus . 41
octona folia . . 67
oleraceae . . 181
opacus 7
operculata capsula . 127
operculum . . 135
opposita folia . . 66
opposite pinnatum folium 62
oppositi rami . . 25
oppositiflorus pedunculus 38
oppositifoliae stipulae . 76
oppositifolius pedunculus 38
orbiculata frons . 74
orbiculatum folium . 53
orbiculus . . 151
orchidea corolla . . 107
orchideae . . 180
ordine duplici dentatum peristoma . . . 136
ordine simplici dentatum peristoma . . . 136
ordo . . . 156
orgya . . . 12
ovale folium . . 53
ovata spica . . . 44
ovata spicula . . 40
ovatum amentum . . 49
ovatum folium . . 53
ovatus strobilus . 139

Palatum . . 109
palea 150
paleacea radix . 17
paleaceum folium . . 68
paleaceum receptaculum 150
paleaceus pappus . 144
paleaceus stipes . . 34
pallide flavens . . 223
palmae . 155, 180
palmata radix . 18
palmatum folium . . 55
palmatus aculeus . 92
palmus . . . 11
panduraeforme folium . 54
panicula . . 47
paniculatus caulis . . 26
paniculata spadix . 49
papilionacea corolla . 107
papilionaceae . . 183
papillae . . 85
papillosa radix . . 20
papillosus . . 9
pappiformis lana . . 145
papposae . . 159
pappus . . 103, 143
papulosus . . 9
parabolicum folium . 54
parapetalostemon . 169
parasitica planta . . 292
parasiticus caulis . 27
parenchyma . . 270
paripinnatum folium . 62
partiale involucrum . 81
partialis pedunculus . 37
partialis petiolus . 37
partialis pinna . . 71
partialis umbella . . 46
partitum folium . 55
partitum perianthium . 99
patens caulis . . 26
patens folium . . 69
patens perianthium . 99

patentissima panicula . 48
Pecten . . 147
pedatum folium . . 62
pedicellata gemma . 90
pedicellatae stipulae . 76
pedicellatum germen . 119
pedicellus . . . 38
pediculus . . 38
peduncularis cirrhus . 88
pedunculata umbella . 46
pedunculatus verticillus . 40
pedunculus . . 37
pelta . . . 151
peltata anthera . 117
peltata frons . . 72
peltatum folium . 68
peltatum indusium . 86
peltatum stigma . 122
pendula radix . . 19
pendulus caulis . 28
pendulus racemus . 46
penicilliforme stigma . 122
pentafora pericarpia . . 165
pentagonus caulis . 31
pentandria . . 171
pentapetalae . . 163
pentapetala corolla . 107
pentapetali irregulares flores 165
pentapetali regulares flores 165
pentaphyllum perianthium 98
pentaphyllus pappus . 144
pentaptera ala . . 146
pepo . . . 131
perfoliatum folium . 42
perfoliatus caulis . 29
perforatum folium . . 68
perianthium . . 97
pericarpium . . . 123
perichaetium . 103, 109
peridium . . 85
Perigonium . . 196
peristoma . . 136
peristomium . . 136
peronatus stipes . . 34
perpendicularis radix . 17
persistens annulus . 82
persistens pappus . 143
persistens perianthium . 98
persistens spatha . . 78
persistens stipula . 76
persistens stylus . . 121
personata corolla . 106
personatae . . 183
pes . . . 12
petaloideum stigma . 122
petalostemon . . 169
petalostemonis . . 168
petalum . . 104, 108
petiolaris cirrhus . 88
petiolaris pedunculus . 38
petiolata glandula . 91, 110
petiolatae stipulae . 76
petiolatum ascidium . 79
petiolatum folium . 68
petiolus . . 36
phoeniceus . . 223
phthiriasis . . . 381
pileus . . . 83
piliferum folium . 70
pilosa anthera . 117
pilosum filamentum . 116
pilosum receptaculum . 150
pilosus . . . 8
pilosus pappus . 144
pilus . . . 93, 95
pinna . . . 71
pinnata frons . . 72
pinnatifidum folium . 56
pinnatum bijugum folium 71
pinnatum cum impari folium 62
pinnatum folium . 62
pinnatus surculus . 35
pinnis confluentibus pinnata frons 73
pinnula . . . 71
piperitae . . 180
pistillum . . 119
placentiforme receptaculum 149
placentiformis radix . 16
plana glandula . 110
plana umbella . . 47
planipetalae . . 163
plantae . . 155
planum anthodium . 102
planum folium . . 65
planum indusium . . 86
planum operculum . 135
planum receptaculum . 149
planus pileus . . 83
planus flos . . . 391
plexeoblastae . . 283
plica . . . 111
plicata gemma . . 90
plicata folium . . 58
plumosa arista . . 93
plumosi pili . . 94
plumosum stigma . 122
plumosus pappus . . 145
plumula . . 140

pneumato-chymifera vasa . 268
pneumatophora vasa . 267
pollen . . . 119
pollex 11
polyadelphia . . 171
polyandria . . . 171
polycotyledones . 141
polygamia . 171, 174
polygonus caulis . 31
polygynia . . 173
polypetala corolla . 104, 107
polypetali irregulares flores 166
polypetali regulares flores 165
polyphylla corona . 113
polyphyllum anthodium 101
polyphyllum involucrum 81
polyphyllum perianthium 98
polyphyllus pappus . 144
polyptera ala . . 146
polysperma bacca . . 129
polysperma capsula . 127
polysperma vegetabilia . 124
polyspermae . . . 163
polyspermum legumen . 133
polystemones . . . 170
pomaceae . . . 183
pomiferae . . 163
pomum . . . 131
Pontederae systema . 168
pori 84
praedelineatio . . 344
praeformatio . . 354
praemorsa radix . . 16
praemorsum folium . . 51
prasinus . . . 223
preciae 182
procumbens caulis . 28
procumbens surculus . . 36
prolifer caulis . . . 25
prolifer flos . . . 396
proliferus surculus . 36
propago 91
proportio . . . 191
propria pinna . . 71
propria vasa . . . 237
proprium receptaculum . 148
proprius petiolus . . 37
prostratus caulis . . 28
pruina . . . 147
pruinosus 9
pubescens 8
pubescens stigma . . 123
pubescentes pili . . 94
pulverulenta frons . 74
punctatum folium . . 60
punctatum receptaculum . 150
punctatus 8
puniceus . . 223
purpureus . . . 224
putamen . . 128
putamineae . . 182
pyxidata frons . . 75

Quadrangulare folium . 55
quadrangularis caulis . . 30
quadrialata ala . . 146
quadricarinatum folium . 60
quadridentatum perianthium 97
quadridentatum peristoma 136
quadrifariam imbricata folia 67
quadrifidum folium . . 52
quadrifidum perianthium . 98
quadrifidum receptaculum 149
quadrifidus stylus . . 120
quadrijugum pinnatum folium 71
quadrilocularis capsula . 127
quadrinatum folium . 61
quadripartitum perianthium 99
quadrivasculares . . 161
quadruplicato-pinnata frons 73
quaterna folia . . . 67
quina folia . . 67
quinatum folium . 61
quinquangulare folium . 55
quinquealata ala . . 146
quinquedentatum perianthium 99
quinquefidum folium . 52
quinquejugum pinnatum folium 71
quinquelobum folium . 55
quinquevasculares . . 161
quintuplinervium folium . 59

Racemus . . . 45
racemosus spadix . . 49
radiatus flos . . . 96
radicale folium . . 64
radicalis pedunculus . . 38
radicans caulis . . 28
radicans folium . . 69
radiciformis caudex intermedius 21
radicula . . 14
radii umbellae . . . 46
radius . . . 96
radix 14
Raji systema . . 162
ramentaceus caulis . 29, 77
ramentum . . 76
rameum folium . . 64

rami 24
ramosa panicula . . 48
ramosa radix . . . 17
ramosa spica . . . 44
ramosa spina . . 92, 101
ramosae lamellae . . 84
ramosi pili . . 94
ramosum filamentum . 115
ramosum folium . . 62
ramosus caulis . . 25
ramosus culmus . . 32
ramosus surculus . 35
ramosissima panicula . 48
ramosissimus caulis . . 25
rara umbella . . 46
receptaculum . . . 148
reclinata gemma . . 90
reclinatum folium . . 69
recta arista . . 93
rectum filum . . . 113
rectus aculeus . . . 92
rectus racemus . . 45
rectus stylus . . . 121
recurvata arista . . 93
recurvus aculeus . . 92
reducentia vasa . . 268
reflexum folium . 69
reflexum perianthium . 99
reflexus caulis . . . 26
remota folia . . . 67
reniforme folium . 52
reniformis anthera . . 116
repandum folium . . 57
repens caulis . . . 28
repens radix . . . 17
repens surculus . . . 36
reticulata radix . . 19
reticulato-venosum folium 58
reticulatum lignum . . 266
reticulatum peridium . 86
reticulatus arillus . . 142
retroflexus caulis . . 26
retusum folium . . 52
revoluta gemma . . 89
revolutum folium . 69
revolutum stigma . 122
revolutus cirrhus . 88
Rhizoma . . . 14
rhizomatoidea radix . 15
rhizoblastae . . 284
rhizospermae filices . 155
rhoeadeae . . 182
rhombeum folium . . 54
rictus 103
rigidus caulis . . 27
rima dehiscens capsula . 128
rimosus caulis . . . 32
ringens corolla . . 105
Rivini systema . . 165
rosacea corolla . . 106
roseus 224
rostellum . . 140
rostrum . . . 146
rotaceae . . 181
rotata corolla . . . 105
Royeni systema . 171
rubigo . . . 375
rugosum folium . . 58
runcinatum folium . 56

Sacculus colliquamenti . 361
sagittata anthera . 117
sagittatum folium . . 53
samara . . . 125
sanguineus . . 224
sarmentaceae . . 181
sarmentosus caulis . . 28
sarmentum 36
sarurate-virens . . 223
scaber 8
scabridae . . . 185
scandens caulis . . 28
scandentes . . 159
scapus . . . 33
scapiformis pedunculus . 38
scariosum anthodium . 101
scitamineae . . . 180
scrobiculatum receptaculum 150
scutella . . . 151

scutiformis radix . 21
scyphifera frons . . . 75
scyphiformis fungus . 85
scyphus . . 91
secunda panicula . 48
secunda spica . . . 44
secundaria vasa . . . 272
secundus racemus . 45
sedecimdentatum peristoma 136
segregata polygamia . 174
semen . . 123, 140
semiflosculosus flos . 96
semilocularis pepo . . 131
seminale folium . . 64
semine solitario herbae . 158
semiradiatus flos . 96

semireticulata radix . 19
semiteres caulis . . 30
semiteres petiolus . . 37
semiverticale folium . 69
sena folia . . 67
senticosae . . . 183
sepiariae . . 184
septis transversis interstinctus caulis . . 31
septuplinervium . . 59
sericeus . . 8
serratum folium . . 57
sesquialteris staminibus . 170
sesquitertiis staminibus . 170
sessile ascidium . . 79
sessile folium . . 68
sessile germen . . 119
sessile stigma . . 123
sessiles stipulae . 76
sessilis annulus . . 82
sessilis anthera . . 118
sessilis gemma . . 90
sessilis glandula . 91, 110
sessilis pappus . . 143
sessilis pileus . . 83
sessilis umbella . 46
sessilis verticillus . 40
seta . . . 39
setaceum receptaculum 150
setaceus pappus . . 144
setaceus stylus . 120
sexflorus verticillus . 41
sexuale systema . . 154
sexus . . . 205
sicco fructu arbores . 162
siccum receptaculum . 148
silicula . . 132
siliculosa . . 173
siliqua 132
siliquosa . . 173
siliquosae . . 183
simplex anthodium . 101
simplex caulis . 24
simplex cirrhus . . 88
simplex culmus . 32
simplex flos . . 95
simplex gemma . . 90
simplex indusium . 87
simplex panicula . 47
simplex peridium . . 85
simplex perianthium . 98
simplex racemus . 45
simplex radix . . 17
simplex spica . 44
simplex spina . 92, 101
simplex surculus . . 35
simplex umbella . 46
simplices herbae . . 161
simplices pili . . . 93
simplicissima frons . 74
simplicissimus caulis . 24
singularis structura . 191, 193
sinistrorsum volubilis caulis 29
sinuatum folium . . 56
sinus . . 71
situs 191
smaragdinus . . . 223
soboles 15
solida radix . . 19
solidus caulis . . . 31
solidus stipes . . 34
solitaria radix . . . 20
solitaria seta . . . 39
solitariae stipulae . 75
solitarius aculeus . . 92
solutum folium . . 68
somnus . . . 10
sorus . . . 49
spadix . . . 48
sparsa folia . . . 66
sparsus caulis . . 26
spatha . . 78
spathaceae . . 180
spathulatum folium . . 54
species . . 156
sphacelatae stipulae . 76
sphaericum capitulum . 41
sphaeroblastae . . 284
spica . . . 43
spicatus spadix . . 48
spiciferae filices . 155
spicula . . 42
spiculatum receptaculum . 150
spina 91
spinosum anthodium . 101
spinosum folium . . 57
spinosus caulis . . 30
spirale stigma . 122
spirales fistulae . . 268
spiralia vasa . . 268
spithama . . 12
spongiosum receptaculum 149
sporadicus morbus . 367
sporangidium . . 137
spuria bacca . . . 139
spuria capsula . . 140
spuria drupa . . . 139
spuria nux . . . 139
spurius fructus . . 138
squama . . 102
squamationes . . 378
squamiforme indusium . 87
squamosa radix . 16, 19
squamosum anthodium . 101

squamosus caudex . . 23
squamosus caulis . 29
squamosus pileus . . 83
squamosus stipes . 34
squarroso-laciniatum folium . 56
squarrosum anthodium . 101
squarrosus pileus . . 83
squarrosus stipes . . 34
stachyopterides . . 179
stamina . . 114
stamineae . . 161
staminiformis corona . 114
stellata folia . . 67
stellata frons . 73, 74
stellata volva . . . 82
stellatae . . 184
stellati pili . . 94
stellatus pappus . 144
sterilis caulis . . 30
sterilis frons . . 73
sterilitas . . . 398
stigma . . 121
stigmatostemon . . 169
stipes . . 34
stipitatus pappus . 143
stipitatus pileus . . 83
stipulae . . 75, 76
stipulatus caulis . . 29
stolo 36
striatus . . . 9
strictus caulis . . 27
strictus racemus . 45
strictus utriculus . . 125
striga . . 95
strigosus . . 9
strobilus . . 139
structura . . 191
stylostemon . . 169
stylostemonis . . 169
stylus . . 120
subalare folium . . 64
subaphyllus caulis . 32
subcordatum folium . . 70
subdimidiato-cordatum folium 54
subdimidiatum folium . 54
suberosus caulis . 32
subferratum folium . 70
subglobosum capitulum . 41
submarinae herbae . 163
subovatum folium . . 70
subramosus caulis . 24
subrotunda radix . . 16
subrotundum folium . . 53
subrotundus sorus . . 49
subspecies . . . 213
subteres caulis . . 32
subulati pili . . . 98
subulatum filamentum . 115
subulatum folium . 55
subulatus stylus . . 120
succosa bacca . . 130
succosa pepo . . . 131
succulenta fila . 114
succulentae . . 181
succulentus arillus . . 142
suffocatio incrementi . 383
suffrutices . . 156
suffulta radix . . 20
sulcatus 9
sulphureus . . 223
superficiarium indusium . 87
superflua polygamia . 174
superius labium . . 109
superum germen . 119
superos flos . . 120
supradecompositum folium . 64
surculus 35
sutura 126
syngenesia . . . 174
synonyma . . 230
systema . . . 152

Tabes . . 382
tela cellulosa . . 270
tenax caulis . . 27
teredo pinorum . 382
teres caulis . . . 30
teres folium . . . 65
teres petiolus . . . 37
teres spicula . . 42
tergeminum folium . . 61
terminale capitulum . 41
terminalis arista . 93
terminalis seta . . 39
terminalis spica . . 44
terminalis spina . 91
terminalis stylus . . 121
terna folia . . . 67
ternato-pinnatum folium . 63
ternatum folium . . 61
tessulatus caudex . . 23
testiculata radix . . 18
tetradynamia . . . 171
tetrafora pericarpia . 165
tetragonum folium . . 66
tetragonus caulis . 31
tetragynia . . . 173
tetrandria . . 171
tetrapetala corolla . . 107
tetrapetali irregulares flores 165
tetrapetali regulares flores . 165
tetraphylla corona . 113

tetraphyllum involucrum . 81
tetraphyllum perianthium . . 98
tetraptera ala . . 146
tetrapyrena drupa . 129
tetrasperma vegetabilia . 124
thalamostemon . . 169
thalamostemonis . . 168
thalamus . . 150
theca . . . 135
thyrsus . . . 48
tomentosus . . . 8
tortilis arista . . 93
tortulosum legumen . 133
Tourneforti systema . 166
tracheae 239
transversus sorus . . 50
trapeziforme folium . 54
trialata ala . . . 146
triandria . . 171
triangulare folium . . 55
triangularis caulis . 30
triantherae . . 169
trica . . . 151
tricapsulares . . 161
trichidium . . 147
tricocca capsula . . 127
tricoccae . . 183
tridentatum folium . 52
tridentatum perianthium . 98
trifarium imbricata folia . 67
trifidum folium . . 52
trifidum perianthium . 98
trifidum stigma . . 122
trifidus cirrhus . . 88
trifidus stylus . . . 120
trifora pericarpia . 165
triflora spicula . . . 42
triflorus pedunculus . 37
trigeminatum folium . 61
triginti duo dentatum peristoma 136
trigonus caulis . . 30
trigynia . . 173
trihilatae . . 182
trijugum pinnatum folium 71
trilobum folium . 55
trilobum stigma . . 122
trilocularis bacca . 130
trilocularis capsula . 127
trilocularis nux . . 128
trilocularis pepo . 131
trinervium folium . 59
trioecia . . 175
tripartitum perianthium . 98
tripetala corolla . 107
tripetalae . . . 163
tripetali irregulares flores . 165
tripetali regulares flores . 165
tripetaloideae . . . 180
triphylla corona . 113
triphyllum involucrum . 81
triphyllus pappus . 144
triphyllum perianthium . 98
tripinnatum folium . 63
triplex corolla . . 390
triplicato-pinnatum folium . 63
triplicato-pinnatus surculus . 35
triplicato-ternatum folium . . 61
triplinervium folium . . 59
tripterigia ala . . 146
tripyrena bacca . . 130
tripyrena drupa . . 129
triquetrum folium . . 66
triquetrus caulis . 30
triseriales lamellae . 84
trisperma bacca . . 130
trisperma capsula . 127
trisperma nux . . 128
triternatum folium . 61
trivalvis capsula . . 127
trivalvis gluma . 100
trivasculares . . 161
triviale nomen . 233
truncata ligula . . . 80
truncata ochrea . . 79
truncatum folium . . 52
truncus . . . 24
tuber . . . 14
tuber lignosum . 378
tuberculata radix . 17
tuberculatum receptaculum 150
tuberculum . 114, 157
tuberosa radix . . 18
tubulosa corolla . 104
tubulosum folium . . 65
tubulosum perianthium . 99
tubulus . .
tubus . . 108, 112
tunica externa . . . 141
tunicata radix . . 19
turbinatum anthodium . 102

Ulna 12
umbella . . 46
umbellatae . . . 184
umbellatum folium . 62
umbelliferae . . 159
umbellula . . 46
umbilicatae arbores . 163
umbilicata frons . 74
umbo . . 84
umbonatus pileus . 83
uncia . . . 11

uncinati pili . . 94
uncinatum folium . . 66
uncinatum stigma . . 122
undulatum folium . . 57
unguis 11, 108
uniflora spatha . . . 78
uniflora spicula . . . 42
uniflorus pedunculus . . 37
unifora pericarpia . . 164
uniformis pappus . . 145
unilabiata corolla . . 106
unilateralis racemus . . 45
unilocularis anthera . . . 117
unilocularis bacca . . 130
unilocularis capsula . . 126
unilocularis pepo . . 131
univalvis gluma . . 100
univalvis spatha . . 78
univasculares 161
universale involucrum . . 81
universalis umbella . . . 46
urceolata corolla . . 105
urceolatum indusium . . 87
urceolatum perianthium . 99
urens 9
ustilago . . . 387
utriculi . . . 270
utriculus . . 124

Vaga spatha 78
vagina 77
vaginatum folium . . 78
vaginatus culmus . . 33
vaginula . . 109
vagus surculus . . . 35
valvula 126
valvulis dissepimento contrariis 132
valvulis dissepimento parallelis 132
varietas . . . 157
varium receptaculum . 150
velutina radix . . . 18
venosae lamellae . . . 84
venoso-nervosum folium . . 59
venosum folium . . . 58
ventricosa spica . . . 44
ventricosum legumen . . 133
ventricosus stipes . . 35
vepreculae . . . 182
vermicularis radix . . 16
verminatio 381
vernatio 10
verruca 147, 378
verrucosum folium . . 66
versatilis anthera . . . 118
verticale folium . . . 69
verticillata folia . . . 67
verticillata frons . . . 73
verticillata spica . . . 43
verticillatae . . . 183
verticillatus caulis . . . 25
verticillus . . . 40
vexillum 107
vigiliae 11
villosa calyptra . . . 135
villosum receptaculum . 150
villosus 8
villus 95
violaceus . . . 224
virgatus caulis . . 26
virginitas . . . 10
vis mortua . . . 247
viscidus 9
viscidus pileus 83
vita propria . . . 246
vitellinus . . . 223
vivipara vegetabilia . 332
volubilis caulis . . 28
volva . . . 81
vulnus . . . 368
Wachendorfii systema . 171

FINIS.

C. Stewart, Printer, Edinburgh.

PLATE. 1.

PLATE II.

PLATE. III.

PLATE IV.

45.
46.
47.
48.
49.
50.
51.
52.
53.
54.
55.
56.
57.
58.
59.
60.
61.
62.
63.
64.
65.
66.
67.
68.
69.
70.
71.
72.
73
74.
75.
76.
77.
78.
79.
80.
81.
82.
83.
84.
85.
86.
87.
88.
89.
90.
91
92.
93.
94.
95.
96.
97.
98.
99.
100.
101.
102.
103.
104.
105
106.
107.
108.
109.

PLATE. V.


110.
111.
112.
113.
114.
115.
116.
117.
118.
119.
120.
121.
122.
123.
124.
125.
126.
127.
128.
129.
130.
131.
132.
133.
134.
135.
136.
137.
138.
139.
140.
141.
142.
143.
144.
145.
146.
147.
148.
149.
150.
151.
152.
153.
154.

PLATE. VI.


155.
156.
157.
158.
159.
160.
161.
162.
163.
164.
165.
166.
167.
168
169.
170.
171.
172.
173.
174.
175.
176.
177.
178.
179.
180.
181.
182.
183.
184.
185.
186.
187.
188.
189.
190.
191.
192.
193.
194.

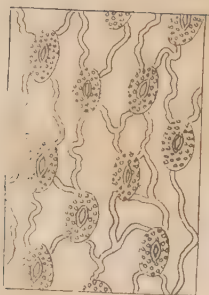
PLATE VII.

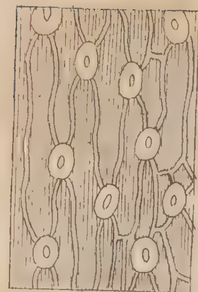

195.
196.
197.
198.
199.
200.
201.
202.
203.
204.
205.
206.
207.
208.
209.
210.
211.
212.
213.
214.
215.
216.
217.
218.
219.
220.
221.
222.

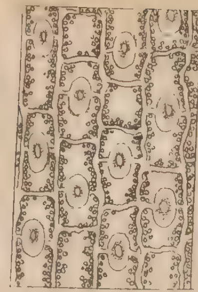
PLATE VIII

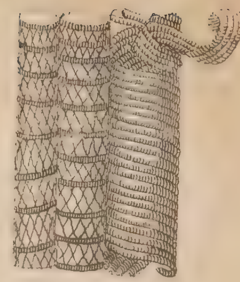

223.
224.
225.
226.
227.
228.
229.
230.
231.
232.
233.
234.
235.
236.
237.
238.
239.
240.
241.
242.
243.
244.
245.
246.
247.
248.
249.
250.
251.
252.
253.
254.
255.
256.
257.
258.
259.
260.
261.
262.
263.
264.
265.
266.
267.
268.
269.
270.
271.
272.
273.
274.
275.
276.
277.
278.

PLATE. IX.

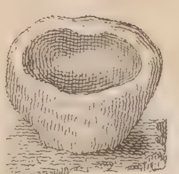

279.


280.


281.

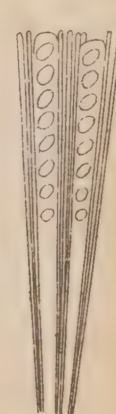

282.


283.


284.


285.


286.


287.


288.


289.


290.


291.


292.

PLATE. X.

J. Moffat sculpt.

PLATE XI.


1 cyaneus
2 coeruleus
3 azureus
4 cæſius
5 atrovirens
6 æruginoſus
7 praſinus
8 flavovirens
9 glaucus
10 luteus
11 ochraceus
12 pallide-flavens
13 ſulphureus
14 vitellinus
15 ferrugineus
16 brunneus
17 fuſcus
18 badius
19 aurantiacus
20 miniatus
21 lateritius
22 coccineus
23 carneus
24 croceus
25 puniceus
26 ſanguineus
27 roſeus
28 atro-purpureus
29 violaceus
30 lilacinus
31 ater
32 niger
33 cinereus
34 griſeus
35 canus
36 lividus
Menſura trium unciarum